MACHINERY.

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COMPRESSED AIR IN THE SHOP.

DESCRIPTIONS OF AIR COMPRESSORS AND COMPRESSED AIR APPLIANCES.

THE various uses to which compressed air is being put in all industries show conclusively that it is an agent of the greatest value for the transmission of power and the performance of certain other functions that come peculiarly within its field. A list of the various uses to which air under pressure is being put, published in the catalogue of one of the leading makers of compressed-air appliances, contains nearly two hundred distinct operations, and there is little doubt that the list could be nearly doubled if the trouble were taken to thoroughly investigate the industrial field. It may be mentioned that the uses of compressed air range from whitewashing to the raising of sunken vessels, but its use for fanning forge fires is undoubtedly the most ancient application in the industrial arts and the one with which the inhabitants of all countries are most familiar.

While its use in the machine shop is by no means a recent innovation, the practical use of compressed air in many shops for the operation of hoists, presses, pneumatic hammers and other shop tools has taken place within a few years. Strange as it may appear, the railroad shops have been the leaders in the use of compressed-air appliances and must be given credit for many novel and ingenious applications well calculated to reduce shop expenses. The reason for this condition of affairs is not difficult to discover as railroad men have had in recent years a practical example of the powers and possibilities of compressed air in the Westinghouse air-brake apparatus. With a number of the Westinghouse air pumps always in the shop, it is not strange that they should have been utilized for shop purposes when so easily set up and operated and naturally one use has suggested another.

Electricity, compressed air and water under pressure are the three mediums for the transmission of power that stand preeminent and each has its field of usefulness which cannot well be filled by either of the others. The most earnest advocate of electrical transmission cannot but admit that compressed air is peculiarly adapted to the operation of such tools as the reciprocating hammer for chipping or riveting, and on the other hand electricity is far superior for the operation of traveling cranes on account of the general flexibility and simplicity of the connections. For the working of presses that are to be operated by fluid pressure and which require a heavy pressure per unit of piston area, the hydraulic system is easily the best as the incompressibility of the water makes a rigid and inflexible medium which is always under instant control and which makes possible an enormous multiplication of pressure in a very simple apparatus. For the operation of an ordinary shop hoist, compressed air is superior to water under pressure in many ways and will usually equal it in economy. Although an air hoist is a wasteful apparatus when working to its full capacity on account of the liberation of the contents of the cylinder under initial pressure it will compare well with the average operation of the hydraulic apparatus. The water hoist for a certain lift always uses the same quantity of water regardless of the weight lifted and the power represented is the weight of the water multiplied by the head in feet. So if a small article be raised by a hydraulic hoist, an amount of power is wasted that is expressed by the difference between the weight of the piece and the weight of the water multiplied by its head. On the other hand the pneumatic hoist needs only enough pressure on the piston to balance the weight to be lifted and the pressure per unit of area may be only a fraction of a pound per square inch. A hoist for any given position is naturally made of sufficient size to raise any piece that is likely to be handled, so it usually is considerably larger than the most of the work requires and as a hydraulic hoist can be superior to the pneumatic form only when the load approaches or equals the limit of its capacity, it appears that the latter is superior in economy when the average of the lifts is taken. The practical advantages of being free from drippings, freezing and other defects inseparable from the hydraulic system makes the pneumatic type incomparably superior for all ordinary uses.

The economical production of compressed air has in recent years attracted the attention of the best mechanical engineers and the problem is found to be far from simple, being as complex in many respects as that encountered in the steam engine. In the steam engine the constant endeavor is to preserve the heat of the steam and to reduce the losses from condensation. This is effected by jacketing and multiple cylinders which reduce the expansion in each unit to that which is found to be most favorable for economy. On account of the storage of compressed air in receivers and pipes, where it must cool down to temperature of the atmosphere, it is poor practice in air compression to expend energy to be wasted in the receiver; so the effort in all the best compressors is to cool the air during compression and lessen the loss from this source. When air is compressed in a non-conducting cylinder, its temperature increases with the increase of pressure. An indicator card taken under these circumstances will show the compression to be adiabatic, whereas the best economy demands that the curve should be isothermal or approach it as nearly as possible. If the compressed air were to be used immediately after compression before it had time to cool, isothermal compression would entail an unnecessary loss, but under ordinary circumstances cooling devices are necessary both for economical production and for mechanical reasons as the heat developed in a compressor working rapidly and under heavy pressures would cause serious trouble if not the destruction of the machine. The best practice requires that the work of compression be done in stages, and we thus find the air compressor the same as the steam engine passes from the simple machine of one piston and cylinder to the double, triple and quadruple compressors which raise the pressure by steps and reduce the heat of compression in inter-coolers. Water jacketing alone in high pressure machines is not sufficient to accomplish the fullest cooling effect as the time the air is in contact with the walls of the cylinder is so short that the cooling is limited to a thin layer which is small when compared to the total capacity of the cylinder.

Cooling by an injection of a spray of water in the cylinder has fallen from general favor on account of the difficulties encountered with the water that is taken up by the air and deposited in the pipes as it cools. The best results in air motors and similar tools are obtained when the air is dry, as moisture always proves troublesome from the freezing in the exhaust ports, being often sufficient to choke them entirely. It therefore follows that the cooler the air supply is before compression the less the trouble from moisture, as the capacity of air for moisture diminishes with a decrease in temperature so that less moisture will be carried in cold air than that having a higher temperature when both have been exposed to ordinary atmospheric conditions. Another advantage that comes from the cool air supply is that the efficiency of the compressor is increased by about 1 per cent. for each 5 degrees decrease in temperature, which

makes it clear that the air supply for a compressor should always be taken from some source besides a hot engine room, as is so often the practice with shop installations.

Compressors for Air-brake Service.

We show in Fig. 18 the Westinghouse compressor or air pump that is generally used on locomotives for the air-brake apparatus, probably compressing more air per day than all other compressors combined, and as intimated before it is used to some extent in railroad shops for a shop compressor. By reason of its construction it necessarily cannot be an economical machine and is not recommended for shop use, being designed entirely for railroad service where economy as compared to reliability is a secondary consideration. In Fig. 19, the air pump manufactured by the New York Air Brake Company is shown in section. This machine is a duplex compressor, the air being compressed in the larger cylinder first and then passing through the smaller one. By reason of the service for which these compressors are designed, no provision is made for cylinder cooling except a recently adopted ribbed construction in the Westinghouse pump, which thus presents a greater area to the atmosphere. Either of these pumps makes a cheap and reliable compressor for shop use where but little free air is to be compressed and where the question of economy is of a secondary nature. It is but fair to state that the duplex form of the New York Air Brake Company will compress air more economically than the simple form using the direct pressure of the steam piston without the intervention of revolving parts.

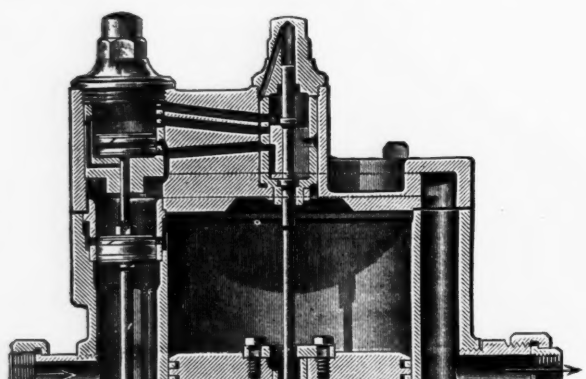


FIG. 18. WESTINGHOUSE AIR BRAKE COMPANY'S PUMP.

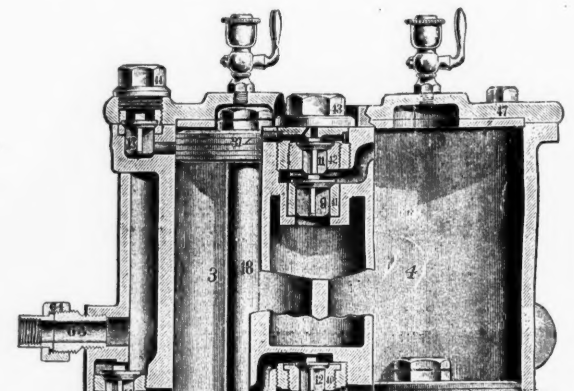


FIG. 19. NEW YORK AIR BRAKE COMPANY'S DUPLEX PUMP.

Steam Actuated Compressors.

In Fig. 2 on pages 112 and 113 is shown an Ingersoll-Sergeant duplex steam actuated compressor of about 125 H. P. which has a capacity of 1900 cubic feet of air per minute. This compressor has the Meyer adjustable cut-off valve for the steam engine and the hollow pistod-rod inlet for the air cylinders. The latter is shown in detail by Fig. 20 and as will be seen the free air is drawn into the cylinder through the hollow piston rod and piston. The inlet valves are located in the piston and of course travel with it throughout the stroke. The valves are indicated by G G and are of ring form. Dowels located at intervals around the piston hold the valves within the limits of the slotted holes through which they pass. By this form of construction no springs are required to seat the valves as they automatically open and close with the reversal of the piston movement. The piston clearance in this form of compressor is reduced to a minimum, there being no countersunk spaces in either the piston or cylinder heads and by the peculiar construction of the inlet valves, the clearance space about them is very small. Two advantages are claimed by the manufactures for the hollow piston and piston rod. The cool air passing through the piston keeps its temperature low so that it is more fit mechanically for its work and again the flow of air is not interrupted but passes through the hollow piston rod in a practically uninterrupted stream. From this construction and that of the inlet valves being without springs, a gain of from 5 to 10 per cent. is claimed over a construction which involves the starting and stopping of a column of air at the end of each stroke. This company also makes a feature of small compressors for pressures up to one hundred pounds per square inch which represents the average shop practice.

The steam-actuated Clayton compressor has a peculiar connecting-rod arrangement by which compactness of construction is obtained and the location of the crank shaft kept in the line joining the two cylinders. This is accomplished by connecting the

steam and air cylinders by a yoke arrangement which passes above and below the shaft and gives room for the connecting rod and crank between the two members. By this construction, steadiness of action by reason of the revolving parts is obtained and also the compactness of the ordinary direct-acting steam pump. The larger sizes of these compressors are built with Corliss cross-compound steam cylinders when so ordered.

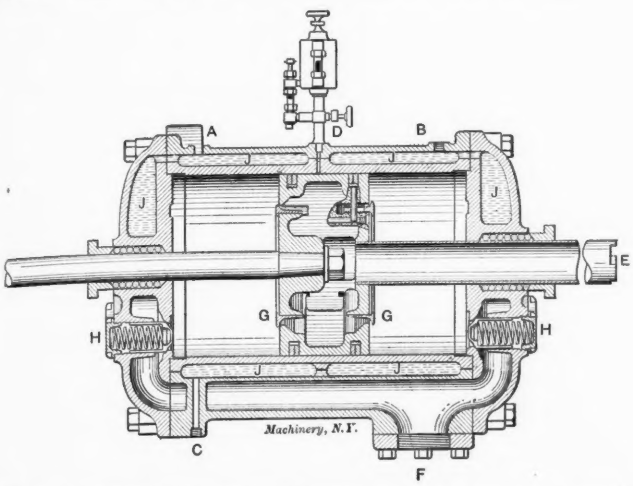


FIG. 20. SECTION OF INGERSOLL-SERGEANT COMPRESSOR CYLINDER.

The illustrations shown in Fig. 21 and Fig. 22 are the Norwalk standard form of compressor and an upright form intended for shop use. The standard compressor built by this well-known company is provided with mechanically-operated inlet and exhaust valves of the Corliss type. The objection to mechanically-operated valves is overcome in this type of compressor by operating the valves only when the pressure on each side of the valves is nearly the same and then they are quickly moved to the proper position by cams, which give a rapid movement at the critical moment. In addition to this arrangement there is an elastic connection that prevents cutting of the valve or seat even if the lubrication be deficient. By having the inlet valves mechanically operated there is no drag on the machine owing to the partial vacuum necessary to lift the spring-actuated valves. Although the vacuum necessary to lift a properly constructed poppet valve is very slight, the Norwalk company claim that the loss is between three and four per cent. at sea level and that it becomes much more proportionately at higher altitudes. The shop compressor illustrated is so constructed that it may be clamped to a 6" vertical pipe and thus use a very limited amount of space, a feature that is often of considerable importance when a compressor is to be installed in an already over-crowded engine room.

One of the most ordinary losses that is too prominent in the ordinary shop compressed-air system is that which results from leaky pipes. As any one knows who has had any practical ex-

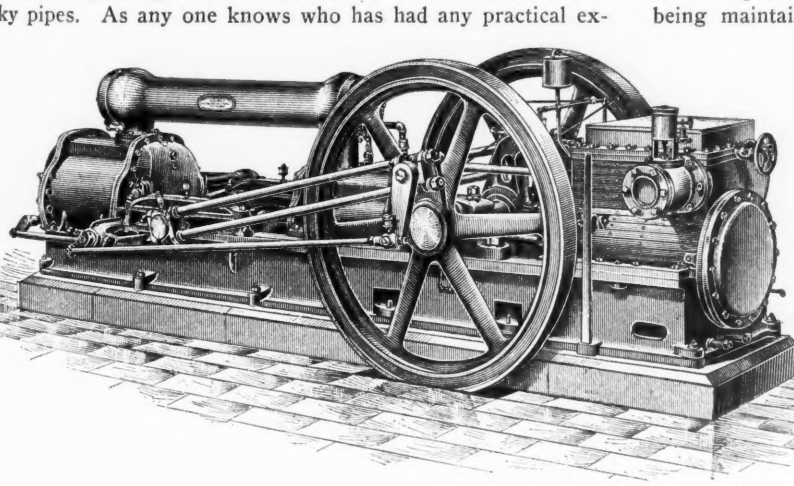


FIG. 21. NORWALK STANDARD COMPRESSOR.

perience, the amount of air that will pass through a very small opening when under pressure is enormous and one of the most necessary features of a shop system is to have all the pipes and connections absolutely tight. While this condition may be somewhat difficult to obtain, it is clearly not impossible when a pipe

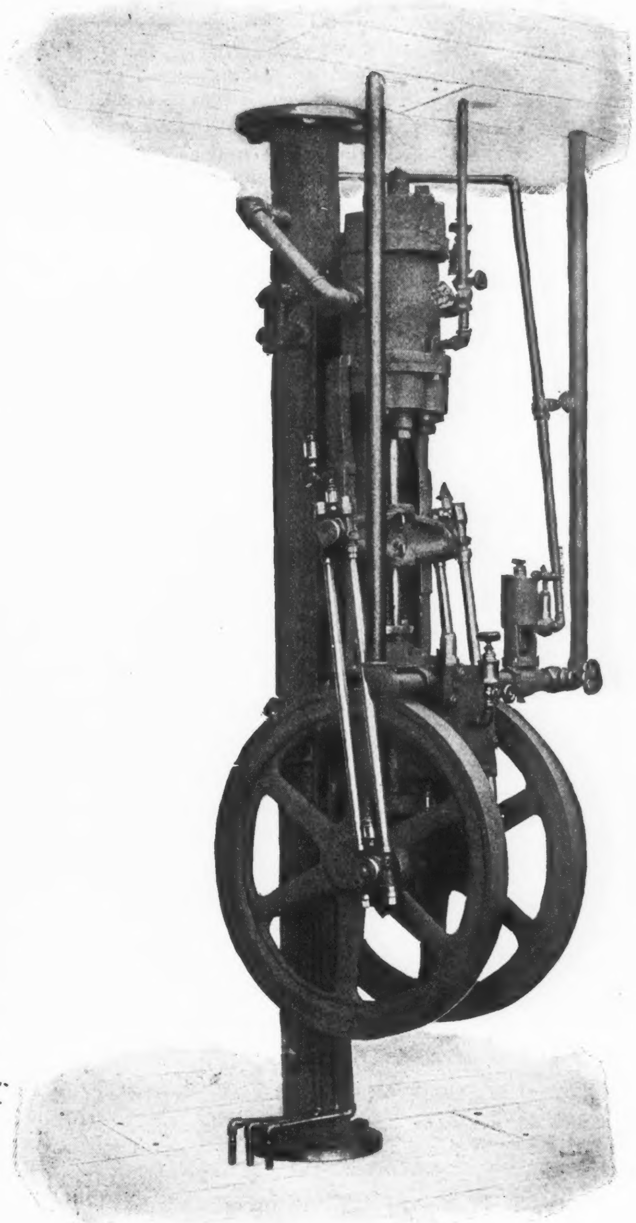


FIG. 22. NORWALK VERTICAL SHOP COMPRESSOR.

line 120 miles long has been laid and found to be "bottled tight" under a pressure of 600 pounds per square inch, the pressure being maintained twenty-four hours without appreciable loss. This remarkable pipe line was equipped with Norwolk compressors and it is safe to say that the efficiency of the compressors was greatly increased with such favorable conditions. If the pipes had been laid as carelessly as they are often erected in shop systems, no compressor, no matter how well built or how efficient in itself, could have given satisfactory results.

A compressor built by the Rand Drill Company is illustrated in Fig. 9 on page 113 and is of the duplex steam engine and compound air-cylinder type, with an intercooler between the two air cylinders, as indicated by the vertical connection between the two. The intercooler is so constructed that the air after having been compressed to the first stage is compelled to circulate in thin streams over a mass of brass or copper pipes through which a constant circulation of water is maintained. The heat of compression is thereby reduced before the second compression and a much more effective cooling effect is realized when the correct proportions between the two cylinders exist, than can be ef-

fected by simple water jacketing. The latter is a good mechanical expedient well calculated to increase the durability of the compression cylinder, but its cooling effect on the delivered air is necessarily quite limited. In compound compressors with intercoolers there is no danger from the disastrous explosions which have often wrecked compressors of the simple type. In the simple form, the air sometimes becomes so heated under favorable circumstances and heavy pressures that the lubricating oils fed into the cylinder "flash" and demolish the machine with attendant disastrous effects.

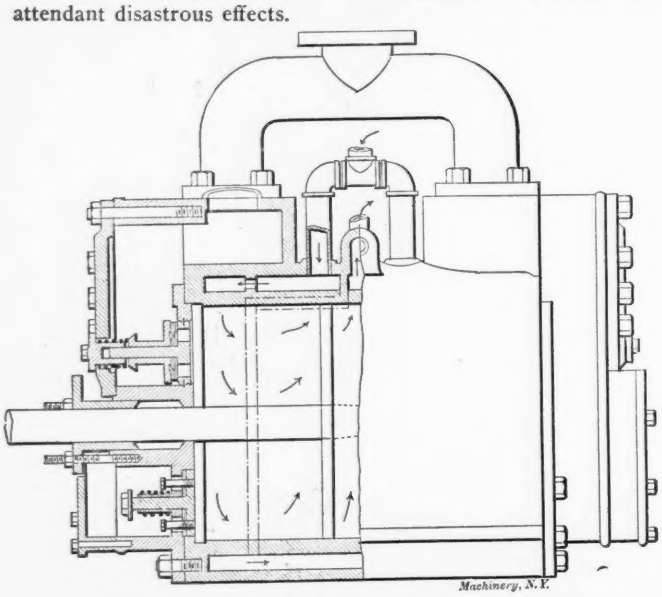


FIG. 23 HALF SECTION OF CLAYTON AIR CYLINDER.

The Rand company make quite a feature of compressed-air reheaters, which are to be used at the ends of long lines and raise the temperature of the air to a degree that is practicable to use in a motor. A great increase of efficiency is obtained by this simple expedient which is said to involve the burning of only about ⅛ of a pound of coal per H. P. per hour. The increase of the efficiency is put at from 25% to 35%, so that if the efficiency of the compressor in delivering the air to the reheater is from 60% to 70%, the use of a reheater will make the total efficiency of the plant 100% or over with an expenditure of a very insignificant amount of coal considering the results. Of course reheating is practicable only where the consumption of air is large as the cost of the attendance would be prohibitive. However, if natural gas or some other source of heat is available that requires no attendance, the reheater enables a considerable gain in economy to be obtained and also renders the motors less liable to freeze up.

The compressors manufactured by the Stillwell-Bierce & Smith-Vaile Company are represented in the two-page cut by Figs. 1 and 3. Fig. 3 shows the type that is calculated for shops that require a compressor of moderate capacity. The cylinders of all machines are water jacketed, the jacket extending into the head as well as around the cylinder. The larger compressors are provided with mechanically-operated inlet valves. In addition to horizontal machines, vertical compressors in single and compound are also manufactured.

Belt-driven Shop Compressors.

The compressor shown in Fig. 8 in the group cut is manufactured by the Clayton Air Compressor Works of New York and is a belt-driven machine suitable for shop use. It is built with the air-inlet valves exposed to the atmosphere so that the air supply can be taken from the room in which the machine stands or the air valves will be enclosed and provided with pipe connections so the supply may be taken from the outside of the building, which is always preferable for reasons previously stated. The air cylinder is provided with an improved water jacket, which is shown in partial section in Fig. 23. The arrows indicate the water circulation, the water is compelled to circulate by reason of the partitions from the center to and around the ends of the cylinder where the heat resulting from compression is the greatest. The water then passes around the center of the cylinder and out at the top, thus tending to preserve an equable temperature throughout the whole, since the water when coldest passes over the hottest portions of the cylinders and then traverses around the central part which is not at the highest temperature resulting from compression.

A neat and effective form of shop compressor (Fig. 7) is that manufactured by Pedrick & Ayer of Philadelphia. This machine is of the compound type, having water jacketed cylinders and trunk pistons. The feature of trunk pistons is an important point in a shop compressor that is to be efficient and run with a minimum of attention. The cooling effect of the water jacket is doubled by reason of every other stroke being a compression stroke instead of each stroke as is the case in the double acting form. In this machine the water circulates around the valve chambers and from there around the cylinders and out at the top, where the heating effect is a minimum. The cylinders are made of double the length of the stroke so that the trunk pistons do not extend over the top of the cylinder at the end of the stroke, thereby preventing the lodgment of dust on the pistons. An automatic belt shifter is provided that will work within a limit of 3 to 5 pounds, and variation of pressure is easily effected by simply adjusting the ball on the lever arm. This company in their catalogue call attention to the fact that it is best to carry the pipe from the machine to the receiver as nearly straight as possible, and it may be added that this advice is equally applicable to all positions. The use of elbows for changing the direction of a pipe should be abolished wherever possible and all changes in direction effected by long bends in the pipe itself. While this practice may entail some additional expense at the outset, it will be found an investment that will pay well. An elbow in an air supply pipe of the shortest possible bend or having a radius equal to one-half the diameter of the pipe will retard

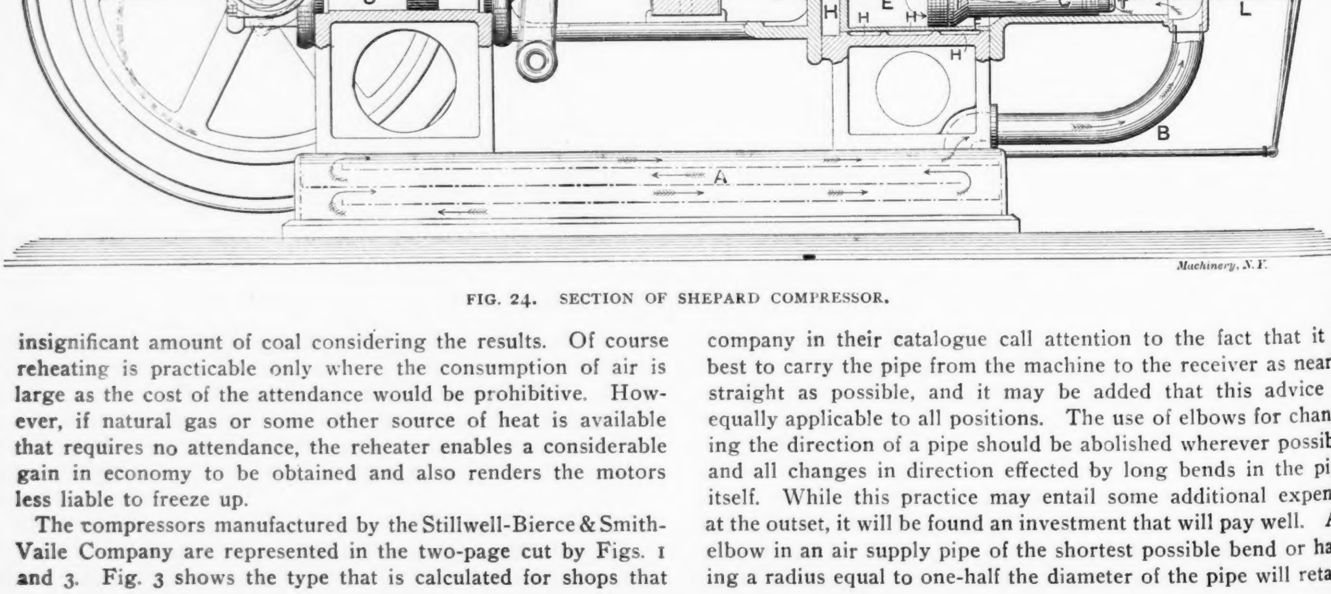


FIG. 24. SECTION OF SHEPARD COMPRESSOR.

the flow as much as 120 diameters of the pipe so an elbow of the above dimensions in an 1½" pipe would be equal in retarding effect to about fifteen feet of pipe. It is evident that a few elbows of this description in a shop equipment will have a serious effect on the efficiency of it, if the pipes be of limited capacity. If necessary to use elbows, use those of as large radius as can be obtained, as the retarding effect is greatly lessened thereby, an elbow of a radius twice the diameter of the pipe retarding the flow only as much as a straight section nine times the diameter of the pipe in length.

We illustrate in Figs. 12 and 15 two forms of shop compressors built by the Curtis & Co. Mfg. Co. of St. Louis, Mo., the one being a simple machine and the other being the compound type. These machines also have trunk pistons and are water jacketed on the sides of the cylinders and throughout the upper cylinder head. The governing mechanism is automatic in action and will regulate the desired pressure within any reasonable limit. The machine has tight and loose pulleys, but the governing is not done by shifting the belts, but is accomplished without stopping the compressor. It also has the feature of being arranged so that by turning a valve the machine may be started without load and compression started after the machine is in motion.

The compound belt-driven compressor shown in Fig. 15 has an intercooler between the high and low-pressure cylinders in addition to the water jackets around the cylinders and in the cylinder heads. This machine is also provided with the automatic governor mentioned in connection with the simple compressor and also has the trunk pistons which render the cooling effect of the jacket more effective. The intake cylinder is provided with a connection on the inlet so that the air supply may be taken from a point outside of the building.

The Curtis Company also build steam-actuated compressors on substantially the same lines as the belt-driven design and also build one with a direct connected gas or gasoline engine.

A Novel Air Compressor.

The Havana Bridge Works of Montour Falls, N. Y., are building a compressor that is of more than ordinary interest and which is illustrated in Fig. 25 and shown in section by Fig. 24. The effort in the Shepard compressor is to obtain isothermal compression as nearly as possible and the method used is very simple. As we have previously stated better results are obtained in the stage system with intercoolers between the compression cylinders than can be realized in any single cylinder machine depending on water jackets for the cooling effect. But in the compound compressor, the first compression cylinder is working under exactly the latter condition although the compressive effect is only a fraction of the total work. The loss in the first cylinder, however, is proportionately greater for the first stage than for the succeeding stages, having equal increments of pressure. The percentage of work lost in compressing dry air when no cooling takes place, the compression being adiabatic, is shown in the following table:

Compression to gauge pressure of	15	pounds,	loss of power	9.2%
"	"	30	"	15.0%
"	"	45	"	19.6%
"	"	60	"	21.3%
"	"	75	"	24.0%
"	"	90	"	26.0%
"	"	105	"	27.4%

This loss occurs on account of the subsequent cooling of the compressed air which always takes place in ordinary practice and of course the nearer the compression approaches isothermal conditions, the less the loss. In the Shepard compressor, the air is drawn into the base of the machine where it passes over pans of cooling water A and through a falling spray which effectually cools and removes dust from the incoming air. It then passes through the passages in the trunk piston C and enters the first compression chamber. The return stroke of the piston compresses the air and it immediately begins to fill the annular space F surrounding the piston, a condition that does not occur in the ordinary systems. In the passage of the air to the second compression chamber it is cooled by passing in a thin stream through the annular valve I and against the inner walls of the water-jacketed cylinder. It will be seen that the compression approaches the isothermal condition as all parts of the cylinder charge are brought in close contact with the cooling surfaces while compression takes place. We are informed that the efficiency of this system of cooling is about 83%, or practically as efficient as the discarded water injection compressors with none of their practical disadvantages.

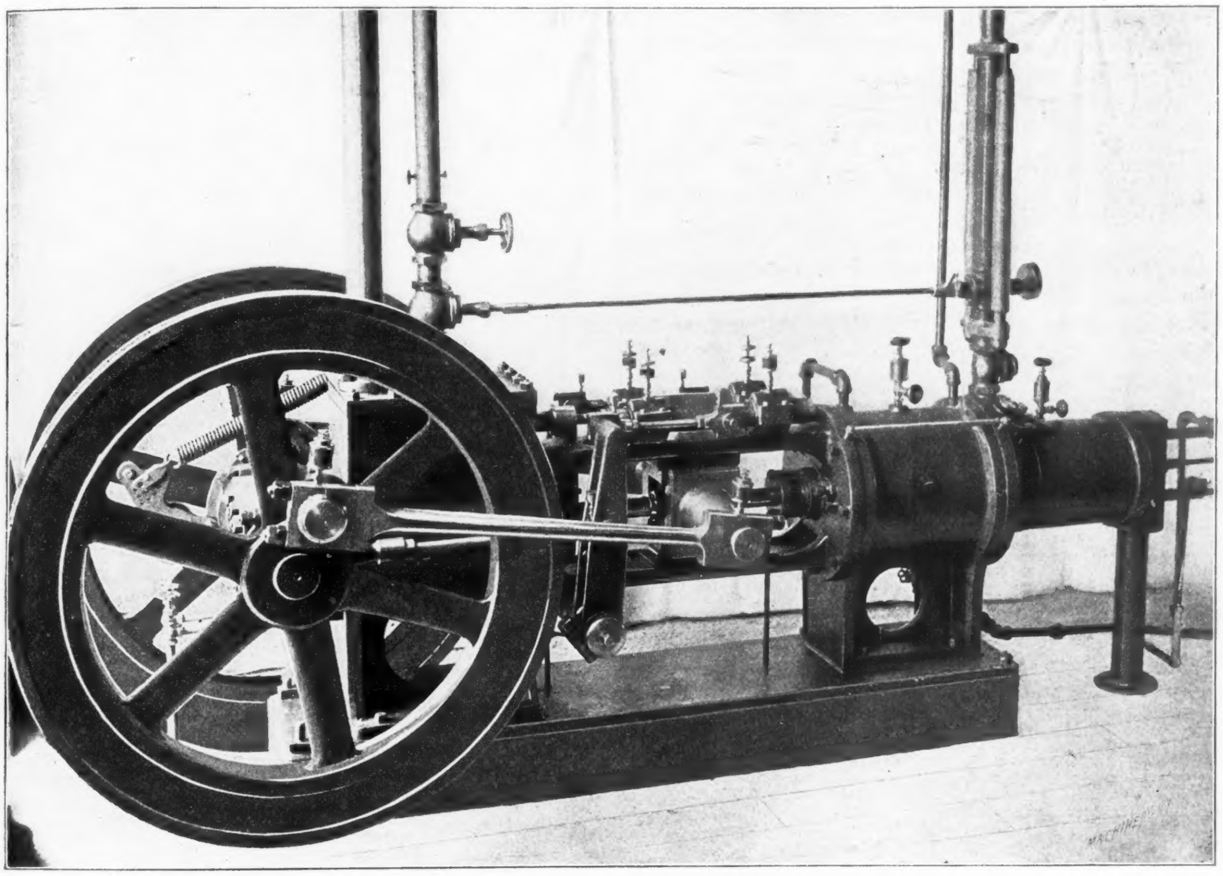


FIG. 25. SHEPARD AIR COMPRESSOR.

The construction of this compressor is simple and is well calculated to find favor on this account as well as its features of economy. The steam engine is of the automatic cut-off type and a novel governing device is used so that a constant pressure will at all times be maintained in the pipe system. An air governor is provided which acts on an auxiliary throttle valve in the steam pipe that is between the main valve and the steam chest. There is a by-pass around the auxiliary valve which allows enough steam to pass to run the compressor slowly when there is no load. When the receiver pressure has reached the maximum point, the air governor shuts the auxiliary valve and then the only steam supply that can reach the engine must enter by the by-pass. The result is that the speed of the engine immediately slackens and the inlet valves to compressor do not open so that the machine continues to run slowly

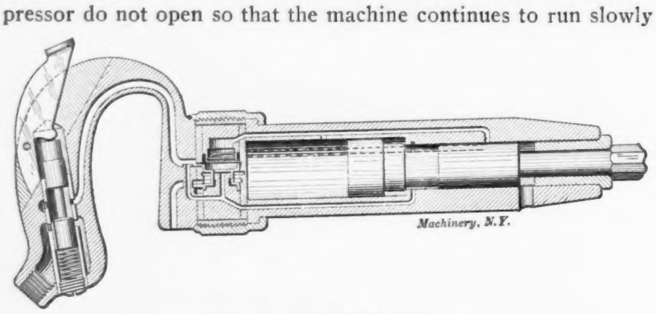


FIG. 26. BOYER HAMMER.

with no load until the pressure is reduced when the auxiliary valve opens and the speed increases. The inlet valves then operate and the work of compression is again resumed.

Compressed Air Hoists.

The hoist shown in Fig. 11 is made by Pedrick & Ayer and is known as their No. 6 style. It is made for lifts from 450 pounds to 14,000 pounds with an air pressure of 80 pounds per square inch at the operating valve. These hoists have automatic operating valves and are air governed. They are manufactured in a variety of lengths to suit the conditions of head room and the lift desired.

A special form of hoist manufactured by the Curtis & Co. Mfg. Co. is illustrated in Fig. 16 which is intended for places where the head room is very limited, and one of their standard straight lift hoists in Fig. 13. These hoists have among other features automatic stops, speed regulators and ball and socket hooks. A speed-adjusting device is of special value in pneumatic hoists as a careless or incompetent operator may cause

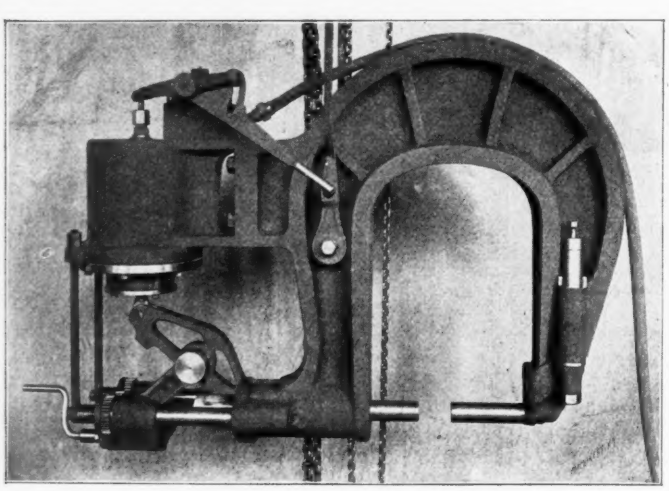


FIG. 27. SHEPARD RIVETER.

serious accidents by raising or lowering too rapidly. The writer has seen hoists made that had no speed regulator except that the throttle valve was very small so that with a full opening the piston could raise a load only at a safe speed. The exhaust valve being of the same dimensions, the lowering was controlled in the same manner. This arrangement can scarcely be commended, especially if the top of the cylinder has a large opening to the atmosphere. Although such a hoist can raise and lower at a limited rate only, there is danger of wrecking it if a chain breaks while carrying a load. The confined air will shoot the piston with great force out of the top and perhaps make a bad accident still worse. The top head in a simple home-made hoist should be provided with an outlet of limited size and then there is no danger from an accident of this kind.

Tools and Appliances.

The pneumatic hammer, used for chipping, calking, beading, riveting and other work, is a very interesting tool, and is being manufactured in a variety of forms by a number of companies. The one illustrated in section by Fig. 26 is the well-known Boyer tool, which is made by the Chicago Pneumatic Tool Company and is adapted in weight and construction to any service required. The new Boyer hammer for driving rivets from 5/8" to 3/4" in diameter weighs 13 pounds and has a piston stroke of 5". The piston reciprocates at a rate of about 1,800 strokes per minute and with an air pressure of 90 to 100 pounds per square inch, the tool uses 20 cubic feet of free air per minute. Where heavy riveting is to be done and the character of the work permits, a yoke riveter made on the same principle can be used

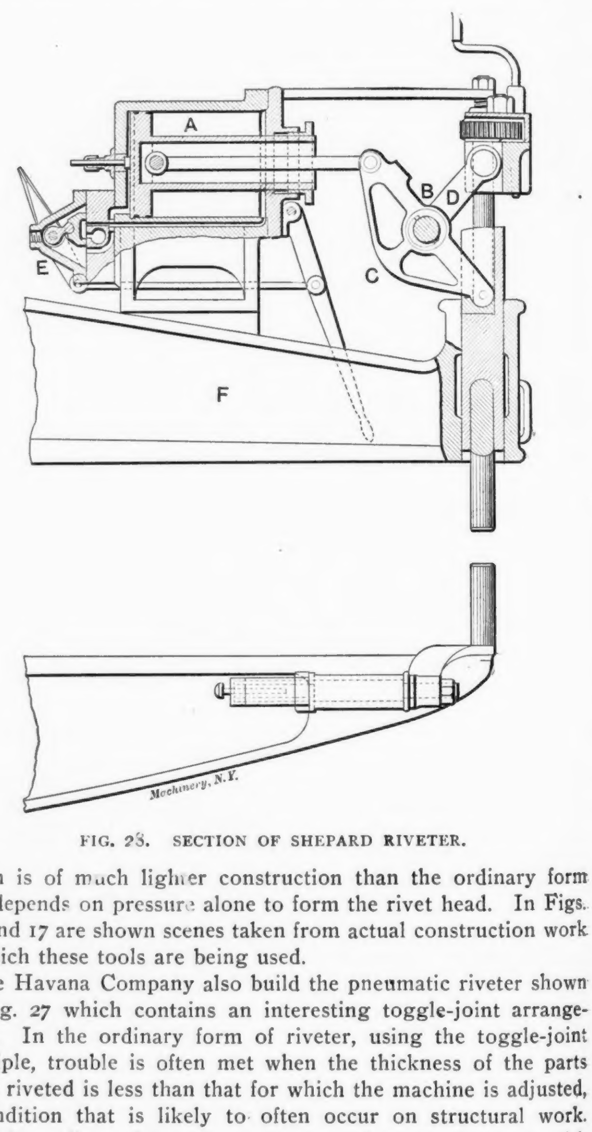


FIG. 28. SECTION OF SHEPARD RIVETER.

which is of much lighter construction than the ordinary form that depends on pressure alone to form the rivet head. In Figs. 4, 5 and 17 are shown scenes taken from actual construction work in which these tools are being used.

The Havana Company also build the pneumatic riveter shown in Fig. 27 which contains an interesting toggle-joint arrangement. In the ordinary form of riveter, using the toggle-joint principle, trouble is often met when the thickness of the parts being riveted is less than that for which the machine is adjusted, a condition that is likely to often occur on structural work. With the ordinary form, the pressure on the parts increases with the approach of the toggle arms to a straight line and would theoretically reach an infinite quantity when the arms finally coincided with the straight line joining their centers. The result is that such machines are often broken or damaged by the enormous stresses developed, but in the Shepard riveter this trouble is obviated by an eccentric pin indicated at B, Fig. 28, which allows the pressure to reach a predetermined amount and then the pin automatically shifts and allows the plunger to advance at a practically uniform rate and thus exert no greater pressure than what the yoke is proportioned to resist.

A pneumatic tool make by the Q. & C. Company is shown in section by Fig. 29 and is known as their valveless hammer, the piston acting as the valve. The construction of this tool is very simple and one easily understood. The compressed air is admitted to the cylinder through a passage of generous dimensions which is not easily clogged and which can be opened and in-

spected throughout with very little trouble. The compressed air being in communication with the annular space around the piston, it tends to drive the piston backwards by reason of the pressure on the rear shoulder, but the air finding admittance to the cavity behind the piston through the ports in the piston as shown in the cut, forces it ahead and delivers the blow but at that moment the ports are opened to the atmosphere. The pressure behind the piston being removed by the exhaust, the

FIG. 29. Q. & C. HAMMER.

pressure under the shoulder which is being constantly maintained, returns the hammer and the cavity behind the piston fills on the back stroke until the pressure overcomes the force of the backward stroke and again drives it forward. A hammer for heavy work that is capable of driving 7/8" rivets and can be held by one man, utilizes the counter-balance principle and greatly reduces the shock and jar incident to the rapid reversal of a heavy piston. In this tool two parts strike alternate blows, one being a piston and the other a movable cylinder surrounding it. A pneumatic tool for lighter work also uses the counter-balance system, but in this tool there are two pistons working in opposite directions and only one delivers a blow on the tool.

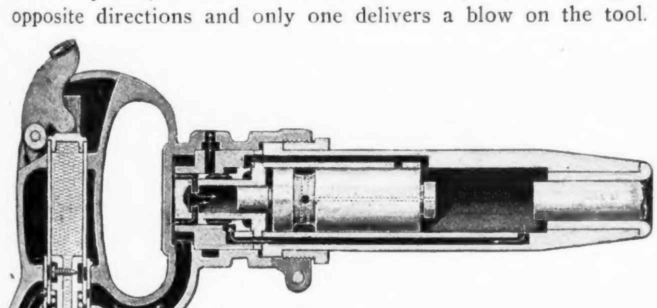


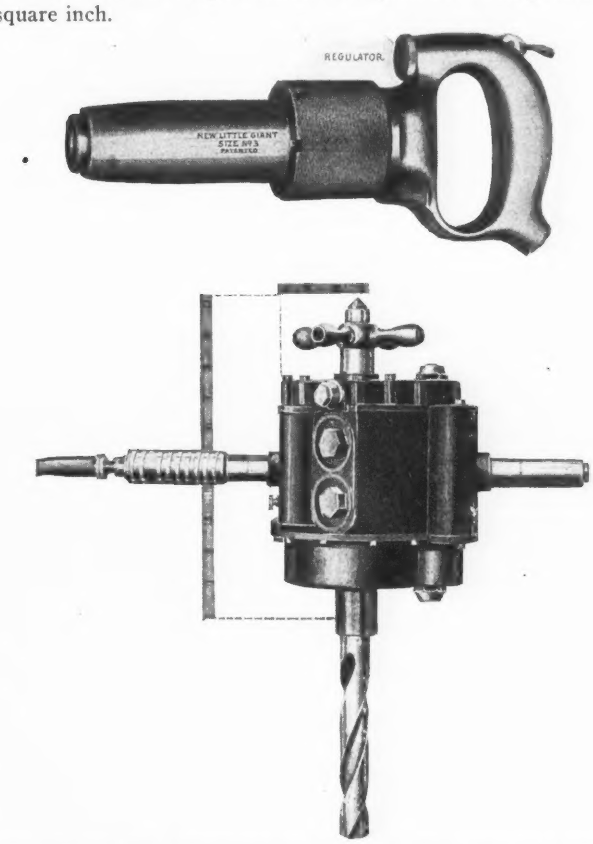
FIG. 30. TILDEN HAMMER.

The function of the other piston is to absorb the shock of reversal and to render the tool more generally agreeable to the operator. This company also manufacture yoke riveters with reciprocating hammers for driving rivets, which have a capacity up to 1¼" rivets. The yoke being of light construction, the riveter is well adapted for work that makes the heavier compression tools unsuitable.

The Standard Railway Equipment Company, of Chicago, are manufacturing pneumatic hammers and air motors suitable for driving drills and other shop tools that may be used in erecting work. Fig. 6 shows the use of their pneumatic hammer in chipping the edge of a locomotive flue sheet. Their piston air drills for machine and wood-working shops are shown also in Figs. 14 and 10. The piston drill for machine shops is well adapted to driving drills and tapping holes in fire-boxes for stay-bolts. Stay-bolts may be screwed in with this machine after the holes are tapped and much time and labor saved. The machine is positively driven so that when the work stops the tool, the air does not continue to blow through as is the case with impulse motors, but has practically the same action as in a piston engine.

The Tilden pneumatic hammer is illustrated in section by Fig. 30 which shows the general construction and also the oil chamber in the handle, which measures out and delivers a constant supply of lubrication to the incoming air. The reciprocating piston and valve are thereby constantly lubricated, a condition that of course increases the effectiveness and durability of the working parts. This tool is to be manufactured by the International Pneumatic Tool Company, of Chicago.

The pneumatic hammer shown in Fig. 31, is made by the Standard Pneumatic Tool Company of Chicago, as is also the piston aid drill shown in Fig. 32. The latter tool is particularly of interest as it is a very powerful and compact tool with the feature of high speed and reversibility by simply turning the grip handle either right or left. The grip handle also admits or shuts off the air supply, the direction of the motor depending on which way the handle is turned by the operator. The same general features are incorporated in a breast drill which weighs eight pounds and will drill holes from 1-16" to ½". The same tool is also made with a feed screw and is said to be the smallest piston air drill manufactured. This style of drill consumes 15 cubic feet of free air per minute at a pressure of 80 pounds per square inch.



FIGS. 31 AND 32. STANDARD PNEUMATIC TOOL COMPANY'S HAMMER AND DRILL.

The pneumatic hammer manufactured by this company has a regulator which admits the air to the cylinder under whatever pressure (within certain limits) is required by the work in hand. The piston is cushioned on the return by the exhaust, thereby increasing the economy and at the same time making the tool easier to hold on account of the reduced vibration. A pneumatic motor chain hoist is also made, which is an application of their piston motor to the worm of a chain hoist, thus doing away with manual labor in the operation of these indispensable shop appliances. It is obvious that this style of hoist possesses some advantages over the piston and cylinder type as it will operate in very limited head room and can also be easily transported to any part of the shop where the air supply is available.

MEETING OF NAVAL ARCHITECTS AND MARINE ENGINEERS.

The seventh annual meeting of the Society of Naval Architects and Marine Engineers was held in this city on Thursday, November 17. There were about 100 in attendance and several of the papers were of unusual interest since they were in a measure based upon actual experience with our naval vessels in action.

The two papers that were of the greatest general interest, both because of the standing of their authors and on account of the importance of the subjects treated, were the one by Admiral Melville upon "Causes for the Adoption of Water-tube Boilers in the United States Navy," and the one by George W. Dickie, Manager of the Union Iron Works, San Francisco, Cal., upon "The Increasing Complications in Warships and how Simpler Arrangements might be Adopted."

As is well known by those who have kept pace with the development of the navy, the day of water-tube boilers for naval work has come, and Chief Engineer Melville, though at one time opposed to them, or at least not satisfied that experience warranted their adoption, has become thoroughly convinced that the type is now sufficiently established and gives so superior results that it is to be preferred to the older Scotch boiler which has held sway for so many years.

The advantages and disadvantages of water-tube boilers are stated by the Admiral to be as follows:

Advantages.

Less weight of water.
Quicker steamers.
Quicker response to change in amount of steam required.
Greater freedom of expansion.
Higher cruising speed.
More perfect circulation.
Adaptability to high pressures.
Smaller steam pipes and fittings.
Greater ease of repair.
Greater ease of installation.
Greater elasticity of design.
Less danger from explosion.

Disadvantages.

Greater danger from failure of tubes.
Better feed arrangements necessary.
Greater skill required in management.
Units too small.
Greater grate surface and heating surface required.
Less reserve in form of water in boiler.
Large number of parts.
Tubes difficult of access.
Large number of joints.
More danger of priming.

He traced the experiences of the navy with water-tube boilers during the past ten years, which, he said, had been favorable, and called attention, among other instances, to the performance of the Marietta, which had these boilers and made the trip around the Horn in conjunction with the Oregon just as successfully as the latter vessel.

The fact that water-tube boilers raise steam quickly is of the greatest advantage. It would have been of the greatest advantage to have had boilers during the blockade of Santiago capable of raising steam in half an hour. Coal need not then have been used to keep all the boilers under steam all the time. The Massachusetts might have shared in the glories of the fight if she had been fitted with water-tube boilers and the Indiana might have kept up with the Oregon which had steam on all her boilers.

The higher steam pressures with water-tube boilers give us smaller and safer steam pipes and better valves. It increases the efficiency of the engines, and, in fact, the use of quadruple expansion engines necessitates the use of water-tube boilers.

Furthermore, for naval vessels with protective decks, the facility with which water-tube boilers can be removed or completely renewed may of itself justify their adoption at times.

Admiral Melville said that he had always opposed the use of boilers containing screw joints in contact with the fire, and had attempted to secure boilers having no cast metal in the pressure parts. Cast steel is not yet good enough to put between 300 pounds of steam and our firemen. He believes in straight tube boilers as being easier of examination and repair than bent tube boilers and in boilers having as few joints as possible. Water-tube boilers must have freedom of expansion of the various parts, and the simpler the boiler the better. It should not be necessary to introduce reducing valves between the boilers and the engines to secure a steady steam pressure at the latter, nor should it be necessary to have automatic feed arrangements to insure steady water level in the boilers. To be successful a boiler must be easy of repair. Lightness is a natural attribute of all water-tube boilers, but it is not wise to go too far in this direction. The ratio of grate surface to fire surface occupied for the complete boiler plant must be as large as possible. The units should be large, the grates short and not too wide. The passage of gases through the tubes should be sufficiently long to insure economy. These gases should be well mixed before entering the spaces between the tubes for the same reason and to prevent smoke. The circulation of the water in the boiler must be free.

Mr. Dickie's paper appeals to one as embodying common sense ideas upon a subject where common sense is need. What may be called the arteries and nerves of a ship are the piping and wiring, which in most instances are so intricate that an engineer may well dread attempting to keep them in working order.

There are also on the modern battleship seventy or eighty auxiliary engines and motors. All of these, as well as the piping and wiring, are a gradual evolution like the growth of the ship itself and the result is that their arrangement is not one of previous planning, but one designed to supply immediate needs.

Mr. Dickie's plan is to have a central passageway running lengthwise through the center of the ship, just below the protective deck, which shall contain all pipes, wires, etc. In this way the pumps for fresh and salt water and for drainage can be located near the boilers and the pressure kept on all the mains all the time, from which direct connections are made to the various compartments. This passageway would also contain the armored tube which protects the wires, speaking tubes, etc. His plan was worked out in detail and seems to simplify greatly the complicated piping and scattered arrangement of the auxiliaries now in vogue.

* * *

THE COMING A. S. M. E. MEETINGS.

The annual meeting of the American Society of Mechanical Engineers is to be held at the society house on December 5 to 8, inclusive. The list of papers is an attractive one, especially to those who are interested in steam engineering. On Tuesday evening, December 5, Admiral Melville will deliver the president's annual address and the professional papers will be presented during sessions on Wednesday morning, 10 o'clock; on Wednesday evening, at 9 o'clock; on Thursday morning, and the closing session will be Friday morning, December 8, at 10.30 o'clock. The subjects of the papers are as follows:

First Session.

Report of the Committee on the Code for Boiler Testing; The Steam Engine at the End of the XIX Century, by R. H. Thurston; Berthier Method of Coal Calorimetry, by C. V. Kerr; Test of Two Pumping Engines at St. Louis Water Works, by J. A. Laird; New Graphic Method of Constructing the Entropy-Temperature Diagram of a Gas or Oil Engine, by H. T. Eddy; Pressure in Pipe due to Stoppage of Flowing Liquid, by George M. Peek.

Second Session.

Liquefaction of Gases, by A. L. Rice; Curved Glass Blue Print Machine, by P. M. Chamberlain; A Metal Dynagraph, by P. M. Chamberlain; Education of Machinists, Foremen and Mechanical Engineers, by M. P. Higgins.

Third Session.

Experiments on Using Gasoline Gas for Boiler Heating, by Herman Poole; Friction of Steam Packings, by C. H. Benjamin; Friction Tests of a Locomotive Slide Valve, by F. C. Wagner; Note on Fly-wheel Design, by A. J. Frith; A Broken Flywheel and How it was Repaired, by James McBride; Efficiency Test of a 125 H.P. Gas Engine, by C. H. Robertson; Strength of Steel Balls, by J. F. W. Harris; Colors of Heated Steel at Different Temperatures, by M. White and F. W. Taylor.

Closing Session.

Impact, by W. J. Keep; The Southern Terminal at Boston, by H. J. Conant; High Hydrostatic Pressures and their Application to Compressing Liquids; A New Form of Pressure Gauge, by F. H. Stillman; The Value of a Horse-Power, by G. I. Rockwood.

PYROMETERS.

A BRIEF DESCRIPTION OF VARIOUS METHODS THAT HAVE BEEN USED FOR MEASURING HIGH TEMPERATURES.

WM. WALLACE CHRISTIE.

Webster defines "Pyrometer" as "an instrument for measuring degrees of heat, above those indicated by the mercurial thermometer, constructed usually on the principle of registering or measuring, by means of multiplying levers and a scale, the change in length of some expansible substance, on a metallic rod, when exposed to the heat to be measured."

The name was first applied by Muschenbroek, in 1731, to an instrument he devised for measuring changes produced in metals by heat, and it is still sometimes used to designate an instrument of this class invented by him for measuring the expansion of solid bodies by heat. De Saguliers improved Muschenbroek's instrument. Between 1736 and 1780 Ellicott, Wedgewood and Guyten also invented instruments of the same character, but none of them give accurate results for very high temperatures. In 1881, Professor Daniell invented his pyrometer, for which he received the Rumford medal of the Royal Society. Daniell's instrument consisted of two distinct parts—a register and a scale. The register was detached after reading the scale in a known temperature, and exposed to the heat to be measured, after which

(P). The microscope (C) enables change in temperature to be easily noted, and with considerable accuracy.

In 1851 Mr. Ericsson produced a pyrometer in which temperatures were ascertained by the tension of a permanent volume of air or nitrogen measured by a column of mercury under a vacuum.

M. F. Becquerel, of Geneva, in 1864, suggested a thermo-electrical apparatus, which has been proved very reliable.

C. W. Siemen's electrical resistance pyrometer will measure the hottest furnace heat.

Deville, Troost and Regnault proposed instruments similar to the air thermometer. Ducomet suggested the employment of a series of alloys having a known melting point, which method has been developed by Carnelley.

The Ducomet pyrometer is constructed on a principle which makes it applicable only to approximate determinations. A series of rings made of alloys, with a different melting point, are placed over a rod and compressed by a spiral spring. Then the melting temperature of a certain ring is reached, it is squeezed out and the rod jumps up one interval, thus indicating successive higher temperature as they are reached.

The following table will be of value to those desiring to ascertain temperatures at any particular time.

Melting point of	Tin......	228 deg. C.	Lead......	325 deg. C.
	Bismuth ..	264 deg. C.	Zinc......	415 deg. C.
	Cadmium .	315 deg. C.	Aluminum	700 deg. C.

Gauntlett makes use of the difference of expansion of two

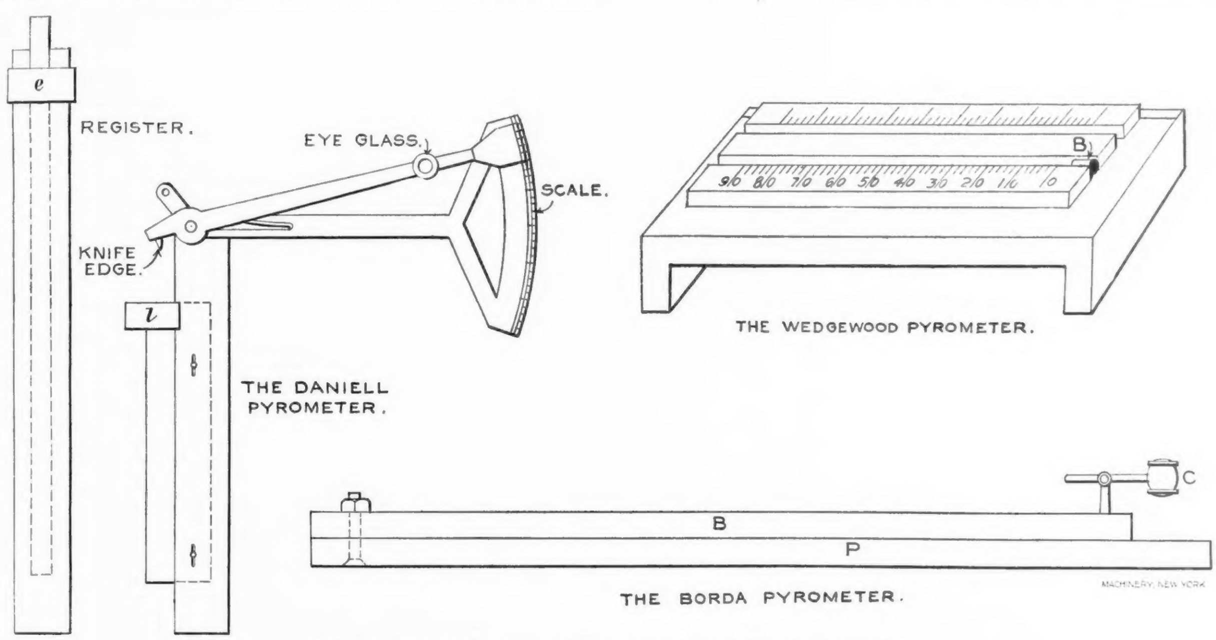


FIG. I. DANIELL'S, WEDGEWOODS AND BORDA'S PYROMETERS.

it was replaced in the scale and a reading taken of the temperature to be measured. Professor Daniell adopted the doubtful assumption that equal increments of length are the effects of equal increments of heat. The register, before heating, is placed on the scale (e) being set on (l).

Wedgewood's pyrometer consists of three copper bars 6 inches long, fixed upon a metal plate with a distance of ½ inch between the first and second at one end and 1-12 inch less at the other end. The second and third bars are the same distance apart as the narrowest part of the slot between the other two at one end and 1-12 inch less at the other.

A one-half inch bar of potter's earth is placed in the heat to be measured, then removed and cooled, when it is moved along the wedge-shaped slot as at (B) until it just fits, and the temperature is read from the scale. The instrument, however, is not very accurate.

Brogniart's pyrometer is similar to Wedgewood's, and consists of a steel, silver, or platinum bar, placed in an oven, one end being fixed and the other acting on a porcelain rod, which projects from the furnace. This rod presses against the short arm of a bent lever passing in front of a graduated scale. Borda's pyrometric standard was devised originally as the measure of the great arc of the meridian in France.

It consists of a brass bar (B) pivoted at one end to a bar of platinum (P) of nearly equal length, a scale being marked on

rods which causes the rotation of a pointer on a graduated dial.

Trampler uses a hard porous rod of graphite in an iron tube, which when heated expands more than the rod.

Carnelley and Burton, in 1879, claim the invention of a water current pyrometer. The difference of temperature between inflow and outflow in copper tube coiled over the fire, which on comparison with tabulation of results obtained at known temperatures, enables the proper temperatures to be closely approximated.

Amagat's and Saintignon's 1883 pyrometers are similar to the above. M. de Saintignon's pyrometer has been used with great success in blast furnaces, glass works, porcelain houses, and other operations requiring very high temperatures.

Saintignon's pyrometer consists of two thermometers (AA), Fig. 2, connected to the main tube with a hose. Water with a head of 10 feet from reservoir (R) passes through filter (F) and then floods the thermometer bulbs (AA). The parts are so planned that 25 deg. raise in furnace heat produces 1 deg. at the thermometers. A movable scale (S) is provided, which is properly graduated.

Messrs. Boulier Bros. patented in 1883 another form of water current apparatus, the difference being one of detail only.

Siemen's first pyrometer was of the calorimetric type, followed in 1860 by an electrical device based on the principle that the electric resistance of metal conductors increases with the temperature.

Berthelot's U mercury-gauge pyrometer is another method for measuring high temperature, but is unreliable as is shown by Recknagel and Mills.

Shaeffer and Budenberg also have made use of the tension principle, the value of which machine depends on the tightness of the joints of the closed reservoir.

Freu's pyrometer for measuring hot blast temperature makes use of expansion of air, due to heating and moving a colored liquid over a properly graduated scale.

The formula for the Metal Ball pyrometer is:

$$X = \frac{W(T - t)}{w\,S} + T$$

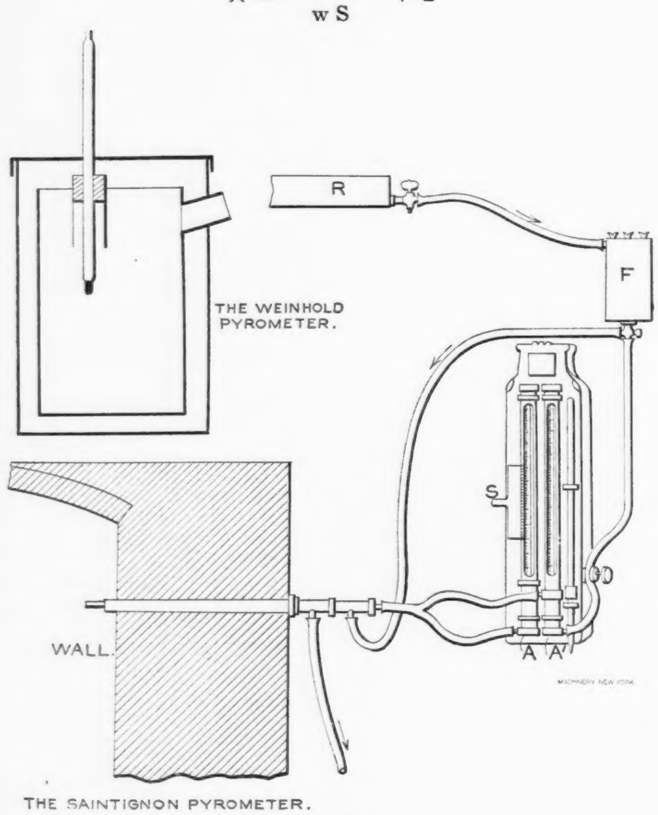


FIG. 2.

w	weight of water.
W	weight of ball.
t	original temperature of the water.
T	final temperature of the water.
S	specific heat of the metal in the ball.
X	temperature of the fire.

Le Chatelier's thermo-electric pyrometer is based upon the principle of the measurement of a current of electricity produced by heating a two wire couple, the galvanometer being used to measure the current.

The following table shows the temperatures in degrees Fahrenheit and Centigrade at which the various phenomena take place:

At Deg. F.	Deg. C.	
212	100	Water boils.
618	326	Lead melts.
676	358	Mercury boils.
779	415	Zinc melts.
838	448	Sulphur melts.
1157	625	Aluminum melts.
1229	665	Selenium boils.
1733	945	Silver melts.
1859	1015	Potassium sulphate melts.
1913	1045	Gold melts.
1929	1054	Copper melts.
2732	1500	Palladium melts.
3227	1775	Platinum melts.
2075	1135	White cast iron melts.
2228	1220	Grey cast iron melts.
2651	1445	Semi-mild steel melts.
2570	1410	Hard steel melts.

In a recent issue of the "Iron Age" Dr. R. Moldenke describes a modification of the Le Chatelier pyrometer. As formerly made, it contained two wires, one of platinum, the other an alloy of platinum with 10 per cent. rhodium, and enclosed in a porcelain tube for insertion to the furnace. The modified instrument has an iron tube around a portion of the length of the wires which is bent to an angle of 90 degrees, and at the end a clay tip is placed about the joint of wires. The tip can be placed in molten metal, and in case of its destruction it can be easily replaced.

The Wiborgh Air-Pyrometer is of the class designed by Regnault, and is adapted to blast-furnaces, tempering furnaces, etc., where determinations from O deg. to 2400 F. deg. are desired.

Seger's pyrometer is a series of slender, triangular fire-clay pyramids which are placed one above the other, and the tumbling over of one after another, as their limits of plasticity are reached, is an indication of the temperature reached—when previously determined for the same materials by some absolute method.

Mesure and Nouel's pyrometric telescope is by far the most convenient, and, giving immediate results, is invaluable when a number of consecutive readings are required, and is in the form of a little telescope which is convenient to have about the person. The principle of its operation depends on the polarization of light.

The Uehling and Steinhart pyrometer is one of the later inventions, and it makes use of the law of the flow of gas through minute apertures.

Tremeschino's pyrometer works on the principle of expansion of a thin plate of platinum, heated by direct contact with a mass of metal previously heated to the temperature desired, and is considered reliable up to 800 C.

The calorimetric method may also be applied to pyrometry with success. A body of known specific heat may be raised to an unknown temperature and then plunged and allowed to remain in a constant volume of water, the temperature of which is measured both before immersion and after it has taken all of the heat possible from the body heated.

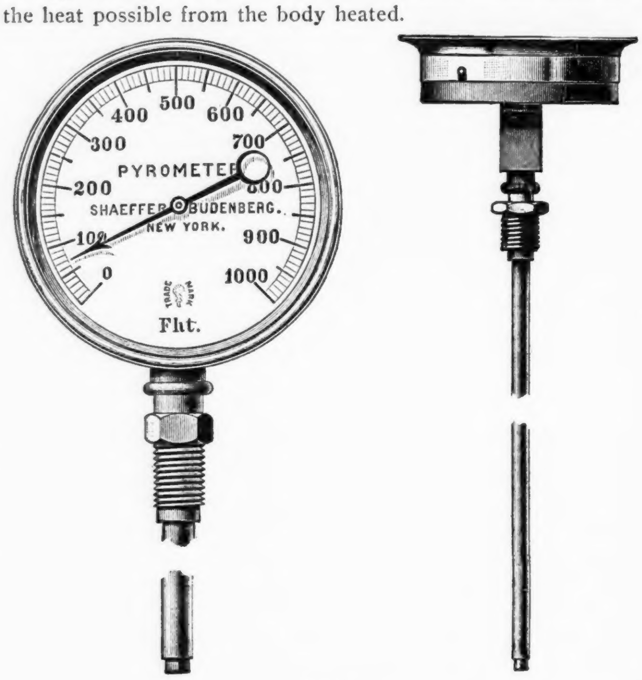


FIG. 3.

The vessel should be well jacketed with polished sheet metal. Bystrom employed a platinum ball to be heated in a clay tube, the ball then being suddenly placed in a water calorimeter. Siemens used a similar arrangement, but with movable scale on the thermometer tube, which, however, proved faulty.

Weinhold's pyrometer consists of an inner vessel made of tin plates with two openings, one being for the thermometer and one through which are placed the iron balls. The capacity of the inner vessel is one liter of water. The outer vessel is of tin also, packed with cotton wool and closed with a lid through which projects the thermometer tube. Three balls of wrought iron, weighing twenty grains each, are used, and by means of special formulae the temperature measured may be calculated.

The writer has experimented with a cast iron ball, placing the same in a boiler furnace and immersing it in a metal case of water, which was previously weighed; but the can was not

jacketed, and the cast iron was very hard to handle at furnace heat, being very liable to crumble. The determination was a heat higher than that at which cast iron is said to melt, so he cannot recommend as absolutely reliable any such crude outfit as was used. It should be borne in mind that the water in the vessel and the vessel itself should be raised to a temperature nearly as high as one would expect the immersed ball to raise it before the ball is heated.

Ganot's Physics gives these formulae for finding the specific hea: of a body:

$$c = \frac{m(\Theta - t)}{M(T - \Theta)}$$

where C = its specific heat,
M = weight of cold water in vessel,
Θ = temperature to which water is raised,
T = final temperature of the body,
t = original temperature of the water.

After making correction for the vessel of brass, which is polished, m = weight; C = specific heat; t = temperature of water, then

$$M\,c\,(T - \Theta) = m\,(\Theta - t) = m'\,c'\,(\Theta - t)$$

$$c = \frac{(m + m'c')\,(\Theta - t)}{M\,(T - \Theta)}$$

$$\Theta = \frac{M\,c\,T + m\,t + m'\,c'\,t}{M\,c + m + m'\,c'}$$

$$T = \frac{(M\,c + m + m'\,c')\,\Theta - t\,(m + m'c')}{M\,c}$$

Specific heat of cast-iron (Regnault), 0.12893; melting point, 2732 deg. F.

Specific heat of cast-iron (Pouillet), 0.14000.

Specific heat of brass (Nystrom), 0.094; melting point, 1873 deg. F.

The writer experimented by placing a chunk of cast-iron in boiler furnace on the coal. It crumbled quite badly, but one piece weighing 1.36 pounds was placed in an iron can containing 65.88 — 13.24 = 52.64 pounds of water at a temperature of 41 deg. F., which was raised to 51 deg. Considering the specific heat of the vessel as 0.1200 we have:

$$T = \frac{[(1.36 \times 13) + 52.64 + (13\ 24 \times .12)]\ 51 - 41\ [52\ 62 + (13.24 \times .12)]}{1.36 \times .13} = 3118° \text{ F},$$

which was not a very accurate result apparently, but with a jacket vessel and good sound ball more satisfactory work may be done.

* * *

Some interesting figures were recently given by Mr. P. H. Dudley in "New York Railroad Men" regarding the stored energy of heavy passenger trains. It is estimated that a train of 10 modern passenger coaches is 800 feet long and weighs 650 tons. The stored energy in foot-pounds of the train in motion is 172,172,000 foot-pounds at 60 miles an hour, 25,000,000 less at 55 miles an hour, and 22,000,000 less at 50 miles an hour. The locomotives, so far as ordinary train resistance is concerned, would have no difficulty in maintaining the speed when once attained at 50, 55 or 60 miles per hour. To raise the train from a speed of 50 to 55 miles per hour, however, requires over 25,000,000 foot-pounds of energy stored in the train for the higher speed. With an increase of 500 pounds additional draw-bar tension, this would require a run of 10 miles to store the needed energy. A signal or slow-down may reduce the speed, and all the energy from the higher to the lower speed destroyed by the brakes. The energy must be restored to the train before it can regain its running speed, but whether the lost time can be made depends upon the distance to be run and the ability of the locomotive to store up energy in the train much above the average running speed.

* * *

"Bronze" and "brass" are terms that are often used synonymously, but the former material is a compound of copper and tin while the latter is composed of copper and zinc. Bronze originated among the ancient inhabitants of Egypt, before iron was known, and was almost invariably of the proportion of 10 or 12 parts of tin to 90 or 88 of copper.

MACHINE TOOLS, THEIR CONSTRUCTION AND MANIPULATION.—5.

LATHE TOOLS.

W. H. VAN DERVOORT.

On the subject of cutting tools for the lathe we will consider only the more general points, as practice alone can bring out the details of proper form and setting.

The common lathe tool as shown in Fig. 40 is a short bar of tool steel of rectangular cross section having a cutting edge formed on one end by forging and grinding. The cutting edges must be hardened and tempered in order that they may properly cut the metals upon which they operate. The form of the cutting edge depends upon the kind and hardness of the metal to be cut, the amount of metal to be removed and whether the cut is to

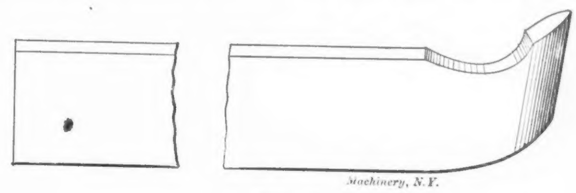


FIG. 40.

be a roughing or a finishing one. These tools when new are made from six to twelve inches long, their length depending upon the size of the lathe in which they are to be used. As the edges wear and are ground away they are redressed, thus gradually using up the stock and finally leaving a short stub, that is, as a lathe tool, of no further value.

Tungsten or self-hardening steel has come into quite general use for lathe tools. It is an "air hardening" steel, and after forging must be kept from water. As it is "hot short" it is exceedingly difficult to forge into any other than the most simple forms. It is several times more expensive than the best grades of ordinary tool steel, and for this reason and also on account of the difficulties met with in forging it, numerous forms of holders for its efficient and economical use have been introduced. In all such tools only the cutting portion is of the self-hardening steel, the holder being a drop forging of mild steel. The cutting portion is of such form that it can be kept in proper condition for work by simply grinding it, thus avoiding the expense of forging. In Fig. 41 is shown an Armstrong tool holder of this class with straight body. It is also made right and left, a left-hand holder being one with the cutting point offset so as to make an angle to the right and a right-hand holder having the cutter pointing to the left. As several cutting points may be used in one holder, a tool of this character frequently takes the place of a number of forged tools.

FIG. 41.

A Hugh Hill left-hand cutting-off tool is shown in Fig. 42. In tools of this class the blade is securely clamped in the holder and may be extended an amount just sufficient to make the required depth of cut, thus insuring the maximum strength of

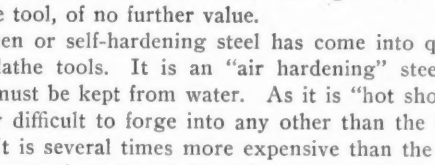


FIG. 42.

blade in every case. The blades are carefully ground to thickness, given the necessary clearance and sharpened by grinding from the end and top. A modification of this tool as shown in Fig. 43 has made a unique and substantial side-cutting tool. These tools are made right and left-hand. The cutting-off tool however, may be had with straight body.

The cutting edge of the lathe tool, as shown in Fig. 44, has what we term an angle of clearance A and an angle of rake B. The angle of clearance has the greatest strength value, as the smaller this angle the greater the support given the cutting edge.

For facing, the tool must have some clearance as otherwise the cutting edge is held away from the work. On cylindrical work if set somewhat below the center, it will clear the body of the work but will not properly clear the feed.

The greater the angles of rake and clearance the more acute will be the cutting edge and the finer and smoother the cut. If the edge is too acute, however, it will not stand up to the work properly. The angle of rake has the greatest cutting value, as strength of cutting edge prevents excessive clearance.

A tool may have front rake as in Fig. 44, or side rake as in Fig. 45. It is usual, however, to grind it with both front and side rake as shown in Fig. 46. A tool without rake requires greater force to drive it through the cut as it tears rather than cuts the metal. It does not leave a smooth surface and springs the work unduly.

For the same rate of feed a tool operating upon work of small diameter must have a greater angle of clearance than is necessary when used on work of large diameter, as the same feed gives a greater pitch angle in the former case. This is clearly shown in Fig. 47.

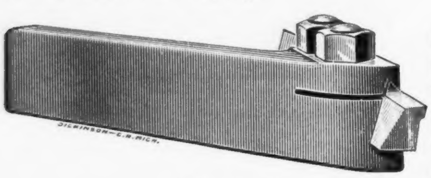


FIG. 43.

It is always desirable when a heavy cut is being taken to have that part of the cutting edge presented to the work as short as the strength and durability of the edge will permit. A straight cutting edge, A Fig. 48, at right angles to the axis of the work presents the shortest possible length of cut, but the delicate point of such a tool will not stand up well. If rounded somewhat as shown at B, we get a cutting length but slightly greater and of a durable form. If the point is too broad as shown at C undue resistance is offered owing to the long line of cutting action.

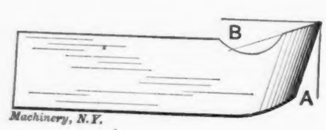


FIG. 44

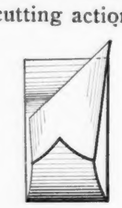


FIG. 45.

That portion of the cutting edge which lies parallel to the axis of the work produces the finish while the portion at right angles to the axis removes the metal. The finishing portion of the cutting edge should be considerably longer than the rate of feed, thus producing a smooth finished surface. If the cut is light and the edge parallel to the axis is long, the tendency for the tool to dip or dig into the work is great and especially so when the angle of clearance is excessive and the cutting edge set high above the center.

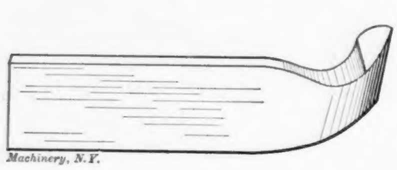


FIG. 46

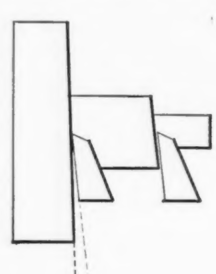


FIG. 47.

In general a tool works best when set for height at or slightly above the center. When above the center any spring in the tool or work causes the tool to dip into the work and leave an untrue surface. Soft spots in the metal or irregular depth of cut will increase this trouble. As the spring comes from the tool post block and points below the cutting edge, setting the tool down to the center of the work reduces but does not overcome this difficulty. If the tool rest was perfectly rigid then a tool having its cutting edge dropped to a line even with the bottom of the tool at point of support would, owing to its own deflection, swing out rather than into the work when set at or below the center. In all cases the tool should be held as firmly as possible and well back in the tool post.

In setting a tool for a heavy cut it should when possible be set raking back rather than ahead as in case of its slipping in the tool post it will swing out of the work rather than into it. This, of course, cannot be done when it is necessary to take the cut close up to the dog or driver.

Cutting-off tools work free and smooth when given an under-rate amount of top rake. As with other tools, however, when

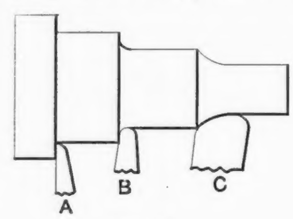


FIG. 48.

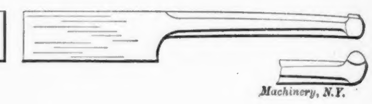


FIG. 49.

used on brass they should have no top rake and will frequently be found to work better with a small amount of negative rake.

The side tool should be given a top rake of from 30° to 40° with a very moderate amount of clearance.

The boring tool as commonly forged from bar steel is shown in Fig. 49. The diameter and length of the stem depend upon the size and depth of the bore in which the tool is to be used. This tool is necessarily a springy one and should, therefore, be as short and heavy as possible, thus requiring a large assortment of sizes for any range of work. The tool shown in Fig. 50 is one of several patent tools which meets the requirements of a first-class boring tool very nicely. The stem which carries a small cutting point of self-hardening steel can be extended for any required depth of bore within the limits of the tool. The same rules for angles of rake and clearance apply to the boring tool as they do to external work.

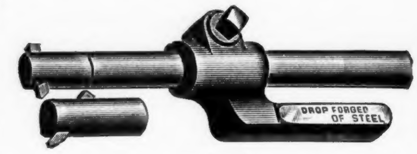


FIG. 50.

A mechanic's success as a lathe hand depends very largely upon the skill and judgment he exercises in the grinding and setting of the cutting tools. They must at all times be kept in proper condition. A dull or improperly formed tool will not do satisfactory work and is frequently the cause of serious injury or accident to the work.

* * *

How long will timber last so as to be safe and reliable for structural purposes, and what is the effect of the weather upon its longevity? This is a question that must depend for its answer upon the climatic conditions and the location of the timber, relative to the ground or water. At a recent meeting of the Association of Railway Superintendents of Bridges and Buildings at Detroit, data were given bearing upon the subject. Long leaf Southern pine leads with records averaging about 15 years when exposed to the weather in bridges located in the Northern States. In Mississippi and Louisiana it is said to last only about eight years. White pine is said to remain sound on an average 10 or 12 years in most sections of the country, though no records are given for the South. Spruce can be depended upon only from 5 to 10 years, and the other timbers like Eastern, Colorado and Northern pine and Oregon fir do about as well as white pine. When protected from the weather all these woods show an ability to last many years. By some who reported they are said to last indefinitely; by others, 40 or 50 years; and in a few cases they are rated with a considerably shorter life, ranging from 14 to 40 years and due, no doubt, to adverse climatic conditions.

* * *

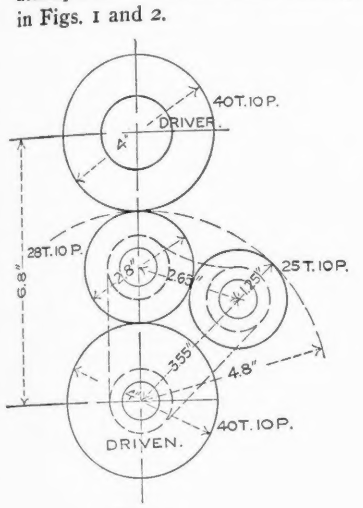
On some of the highway draw-bridges over the Passaic River at Newark, N. J., are notices which contain besides the ordinary instructions to the riding and driving public, an injunction prohibiting the use of "indecent or immoral language" while on these bridges. Whether this restraint on the wicked public while on these bridges is in the interests of good morals or whether the city authorities have discovered injurious stresses on the structures as the result of lurid language is not explained.

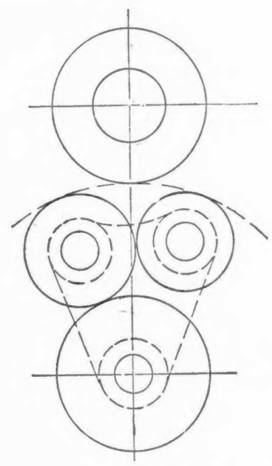
TUMBLER GEARING.

P. J. CONNOR.

A useful device for the purpose of reversing the motion of driven shafts or disengaging them from the driving mechanism is commonly called tumbler gearing, and it is found frequently in headstocks and aprons of engine lathes, planer elevating gearing and many other parts of machine tools.

The device is very old and it is so exceedingly simple that the only purpose of the writer is to cite a few points in the usual construction of it, and also explain a method of making it. Judging from the number of machines that have been examined in the course of investigation, there seems to have been few attempts made to attain the effect produced in the manner shown in Figs. 1 and 2.



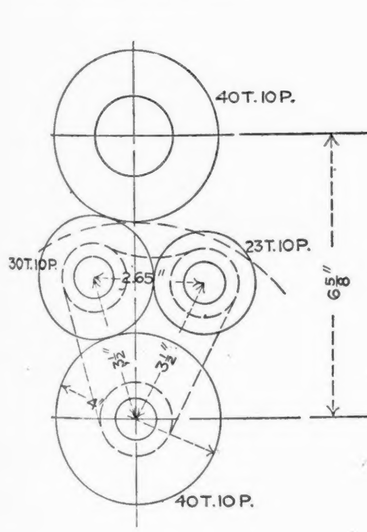


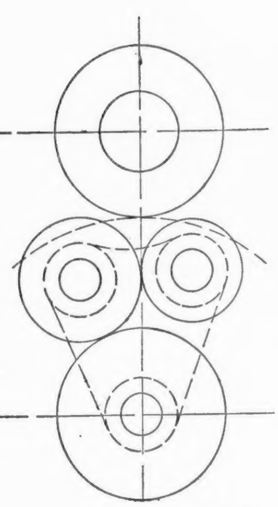
Machinery, N. Y.

FIG. 1. FIG. 2.

Fig. 1 shows a construction which permits of a free motion of the tumbler frame around its axis and is accomplished, as may be seen from an examination, by making the distance between center of driver and driven gears equal to pitch diameter of large tumbler pinion plus ½ pitch diameters of driver and driven gears.

A difference of three teeth in tumbler pinions will usually be enough to give clearance to both driver and driven gears, and care must be taken to select such diameters as will allow clearance when the tumbler gears are entirely disengaged from the driver. When the center for smallest pinion is selected, it will be necessary to make it such that a circle struck from driven gear center will be tangent to pitch circles of both large and small tumbler pinions.





Machinery, N. Y.

FIG. 3. FIG. 4.

Add diameter of large tumbler pinion to one-half diameter of driven gear, and subtract one half diameter of small tumbler pinion from the radius of the tangent circle to obtain the center distance for driven gear and smallest tumbler pinion. Fig. 2 shows the tumbler in position when both pinions are free from driver.

Fig. 3 and Fig. 4 show the form in which tumbler gears are usually made. The arc of a circle struck from the driven gear center tangent with bottom of driver indicates the fact that it would be impossible to swing them freely on the driven gear center, as noted in Fig. 1, to pass under the driver gear.

The effect produced when the tumbler is thrown into engagement will be either to cause the teeth to lock or else to tend to throw it out, all depending on the direction of motion of the driving gear. It is obvious that the construction which is free from the greatest danger of damage to the gear teeth will be the best, and this is, in the opinion of the writer, secured as shown in Figs. 1 and 2.

The use of tumbler gearing for heavy lathes is not as common now as it was at an earlier period. One prominent concern has discarded them on such machines, and, when reversing the lead screw is necessary, it is effected by a second idler on the quadrant.

Another source of trouble is to be found in the studs on which the tumblers run, as they usually are too small for the strains they must support.

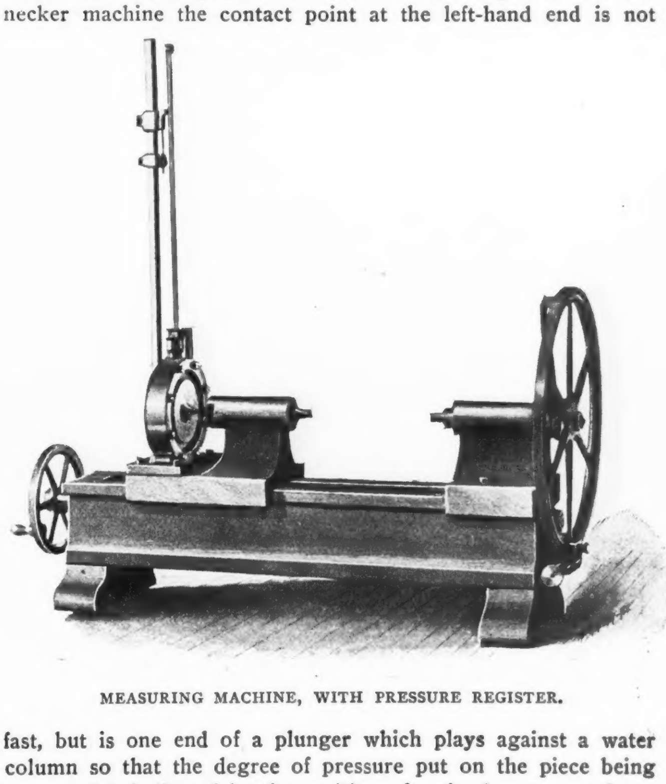
A very good way to make the frame for heavy work is to have it double, thereby having a support for each end of tumbler studs.

* * *

MEASURING MACHINE ATTACHMENT.

ROBERT GRIMSHAW.

In the Reinecker shops at Chemnitz, Saxony, I found a measuring gauge for very fine work which adds to the usual contact arrangement of the "millionth machine," as made popular by Prof. Sweet and others, an arrangement stated to be the invention of one of the brothers Reinecker, by which the amount of pressure between the contracting points can be measured. This insures greater accuracy in measuring as the loose pinch recommended in measuring end to end in such machines varies considerably, so much so that three successive persons measuring the same piece at the same temperature, in one of the ordinary machines, may give three different readings. In the Reinecker machine the contact point at the left-hand end is not



MEASURING MACHINE, WITH PRESSURE REGISTER.

fast, but is one end of a plunger which plays against a water column so that the degree of pressure put on the piece being measured is indicated by the position of a slender water column in a vertical capillary tube. Thus, if the areas of all the test pieces are equal, and all are ground off square and true, the same amount of pressure on any one, or on any two or more, end to end, will always produce the same pressure in the water column, and be indicated by the same height of the level of the latter in the capillary tubes. The delicacy of the attachment of this machine is shown by the fact that with a test bar between the contacts the frame of the machine may be sprung enough with the thumb to make the water-level rise and fall an eighth of an inch or more.

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DECEMBER, 1899.

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The circulation of the three leading papers in the machinery trade, so far as it is possible to obtain the figures, is as follows:

The IRON AGE, about	7,000
The AMERICAN MACHINIST, about	12,000
MACHINERY	18,500

COMPRESSED AIR.

In this number we have presented a descriptive article upon compressed-air appliances for the shop that will be of interest to those who are contemplating improving their shop facilities. The number of concerns now making air compressors and compressed-air appliances, and the extent of some of the shops engaged upon this work are much greater than would ordinarily be imagined. At the same time the orders for these products come largely from mines and quarries and from industrial plants doing structural and boiler work, where there is a demand for punching and rivetting machinery. Machine shop managers as a whole probably do not fully appreciate the benefits and economics to be realized from the installation of a compressed-air system in an ordinary machine shop where nothing but ordinary machine work is done.

The question is often discussed as to which is the better system to install, the compressed air or the electric, and as to which is the more economical. Our answer is that both are necessary. Each has its own place in the modern shop, and a brief consideration will show that neither one can fully take the place of the other. Take the case of a traveling crane, for example. There have been very good cranes of this kind with compressed air as the motive power, but it involves both coiling up and paying out the hosepipe as the crane travels along the tracks or the carriage travels along the crane girders. It involves, also, reciprocating motors which operate at high speed and are noisy and require considerable care. It is clear that electricity must here take precedence, as the easy transference of the electric current by the trolley and the adoption of the rotary and smooth running motor make it far superior. On the other hand, for hoists about the shop and even for jib cranes of moderate capacity, there is no arrangement yet devised that had quite the simplicity, the convenience and the steady action of the air hoist consisting of a cylinder in which a plunger operates directly upon the chain.

In general it may be said that where a motor is necessary electricity is the better motive power to use. Many rotary motors have been devised for utilizing compressed air, but here as with steam the reciprocating motor is likely to hold its own, and for the same reasons, and any who have heard small compressed air motors of this description run can appreciate their disadvantages. Exceptions are to be found, evidently, in the case of small hand motors for drilling and similar operations to which electricity is not at all adapted and where compressed air has been found to give excellent results.

After a compressed-air system has been introduced into a plant the surprising thing is to find to how many uses it will be applied. In the foundry it is far more effective than rattlers for cleaning castings in connection with the sand blast, and its use in operating chipping hammers is well known. Whenever a repair is to be made upon any machine the workman will prefer to attach the compressed-air drill instead of ratcheting a hole. The air pressure will come in handy for testing castings for leakage, for blowing out core sand and many other purposes; and best of all it affords the means of materially reducing that large percentage of time which is spent in handling and setting up work. There is no better way of cutting down this expense than by the introduction of hoists and plenty of them. As far as punches, hammers and riveters are concerned, it is quite certain that there is no better system for them than the pneumatic system.

* * *

SEEKING PROMOTION.

In our correspondence column a contributor sets forth some of the disappointments and failures that a mechanic is likely to meet, who has devoted his time to study with the expectation that his efforts at self-improvement will be rewarded with advancement. We do not doubt that the conditions are very much as he finds them. It is probable that in the majority of shops there is a maximum rate for machinist's wages and that if a machinist be ever so well grounded in the fundamental principles of mechanics and be ever so good a workman, he will find difficulty in securing more than the stipulated rate. Under such circumstances it may sometimes be considered a debatable question whether after all it pays to make efforts to add to one's stock of knowledge in his chosen line of work.

Nevertheless, the average machinist who has, we will assume, only average ability to assist him and who lacks all outside influence or "pull," will probably find that the most promising avenue to advancement is that of study and observation. The machinist's trade is a combination of the efforts of the hand and the mind, and in general the greater the part taken by the mind the greater the compensation.

In some shops the machinist is essentially a hand worker. This is true where there is a great deal of semi-automatic machinery and probably no amount of study would enable one to materially benefit himself as a machinist in such a shop. The remedy, then, is to make an effort to eventually secure a position in a shop where there is an opportunity for the mind to help the hand. If the point is finally reached where there is again no chance for improvement as a machinist, the obvious thing to do is to try to become something else besides a machinist. If the mind becomes so trained that it can earn more money acting alone than when acting in connection with the hand, the hand should be abandoned in favor of the mind.

The difficulty, of course, is that it is not always easy to make a change from one shop to another nor to secure advancement commensurate with one's qualifications. But even under such circumstances it cannot be justly said that efforts at self-improvement are to be counted as lost. Evenings spent in study might otherwise be spent in some useless way and they tend

to develop the ability and character of the student. Also, there will be no loss, if during the shop hours one tries to become familiar with all the ins and outs of his own and the work around him.

What can the average machinist expect to accomplish who does not try to make himself an all-around man, who can work understandingly? If he does nothing to add to his knowledge he will not be rightly called a machinist—he will be simply a "hand," who works entirely with his hands. Other things being equal, the more knowledge he gains the better machinist he will make; and if he becomes a competent machinist he will then be in a way to become a foreman or secure other promotion if opportunity offers. If he does not become a competent machinist, he can feel reasonably sure that such an opportunity will not offer itself, and that if it does, he will not be able to hold the position. If no opportunity comes, the man who is prepared will still have the satisfaction of being a capable machinist, and we doubt whether after all there is any greater satisfaction to be obtained than is realized in doing intelligent work as a machinist in the shop.

* * *

NOTES FROM NOTOWN.

ASKING ADVICE AFTERWARDS—LEARNING A TRADE.

I. Podunk.

Locking the kitchen door after the policeman has eloped with the cook isn't any worse than is done every day in the engineering world, or, perhaps I had better say in the world of investors in engineering products; and when you consider it, this applies to about every other line as well.

I've had two callers the past week, and one was just this kind of a man—only he wasn't sure whether he wanted to lock the door or not—that's what he called to see me about. He was the head of a large grocery firm in Boston, and if any one went to him with a scheme for embalming eggs or making baking powder out of sawdust he would turn him down in a minute—probably wouldn't take time to show him where his plan was weak.

Nevertheless, he was an easy mark for a rotary engine crank, and blew in his hard-earned cash on what is just as much a fake as the aforesaid sawdust baking powder. In other words, he knows groceries, but he doesn't know steam engines, and the only mistake he made was in not coming to see me or some other mechanical chap before going in on the ground floor for preferred stock. He evidently got uneasy about it, and he came to me for advice or consolation, I don't know which. After remarking on the yacht race, or the "trying to race," he said: "Ike, have you ever seen the Seymour rotary engine? If you haven't I'd like to have you look at this and tell me what you think of it," and he drew out his patent papers.

I had seen it, but I let him explain its beauties and economies until he got tired, then he asked what I thought of it. "Mr. Jones," said I, "that engine is as good as lots of rotaries I can show you, but isn't a bit better than a dozen others. None of them are worth a continental for power purposes except in special cases. This one is first cousin to the Haeseler air motor of Philadelphia, only it isn't as good, and Haeseler is too good a mechanic to think of using it for steam power purposes. For pneumatic drills, where you are only competing with hand power, rope or belt transmission, or a small electric motor, the rotary air drill can hold its own, but for power it isn't in it for a minute."

"But it'll go, Ike; I've seen it; and it's so small for a twenty-horse motor that it can't use much steam. Seymour says it is way below the best engines and so does an expert engineer who examined it. Besides, we've been offered $7,000,000 for the State right to build it, and there must be something in it or they wouldn't do that. Guess you must be off this time, Ikey; p'raps you're getting too old to appreciate these new things."

When a man calls you old, even if hair has been a stranger to your head for several seasons, you immediately get riled; but to be called a back number just brings up all the fighting blood you ever had. However, I didn't fight. He was bigger than I and chances for running were not good. So I calmed down to the dignity point and said: "Mr. Jones, anything will go if it has steam enough behind it, but will it go any better or any cheaper than a lot of others?" He didn't know it, but these are almost the identical words I heard Brown say to old Rodnock: "It's hard to build anything that won't go, but buyers must be assured that it will keep on going and use less coal than any other. And it won't do to compare it with another rotary, either; such comparisons are like a burglar putting on a "holier-than-thou" expression when he passes the cell of the chap who is awaiting electrocution. To get his true value he wants to compare himself with the warden, or some one not a criminal; compare with the best there is and see how they stand.

"And, speaking about experts' reports, did you ever see Tom Pray's report on the Bates thermic engine? No! Well, you had better get one. Pray's name probably caused more stock to be sold by that concern to people who knew he was a consulting engineer than could have been sold otherwise, and yet the engine was one of the greatest failures that we have seen for years; and I've been told that Pray had to sue the company for his fee. This was low-lived business, because the wear and tear on a man's conscience in writing a report like that deserves to be paid for, and if an expert's report could make an engine successful that one would certainly have proved the gold mine of modern steam engine building.

"If you've been offered $7,000,000 for State rights, or even for the whole thing, don't rest till you've accepted the offer and got your money. Don't be greedy, Mr. Jones; $7,000,000 would buy you cigars and soda for several days. And if you can't get the whole $7,000,000 I'll advise you to take less—even $7 rather than hold on to your engine. Every dollar you get now is clear gain, for you might just as well count what you've paid in as being thrown away.

"Now, I'm not trying to discourage you in the least, Mr. Jones, but you'll be money ahead by following my suggestions. And it won't be many years before you'll think my advice worth more than that of the experts. I'll send in my bill when that time comes. The better way would have been for you to come to me or somebody else before you put your money into a scheme of this kind. If I went into a wild scheme in the grocery trade, something I know nothing about, and then consulted you afterward, you would probably feel rather disgusted with me. Well, that is exactly what you've done with regard to your rotary engine, and you mustn't wonder if I haven't been very sympathetic. Good day, Mr. Jones." I've probably made an enemy for the time being, and will be reviled as an unprogressive old fogy, but—we shall see.

One of my nephews wanted to learn to be a mechanical engineer, and wanted my advice. He had a chance to go to a State school for three years, and didn't know whether to do it or to go direct into the shop.

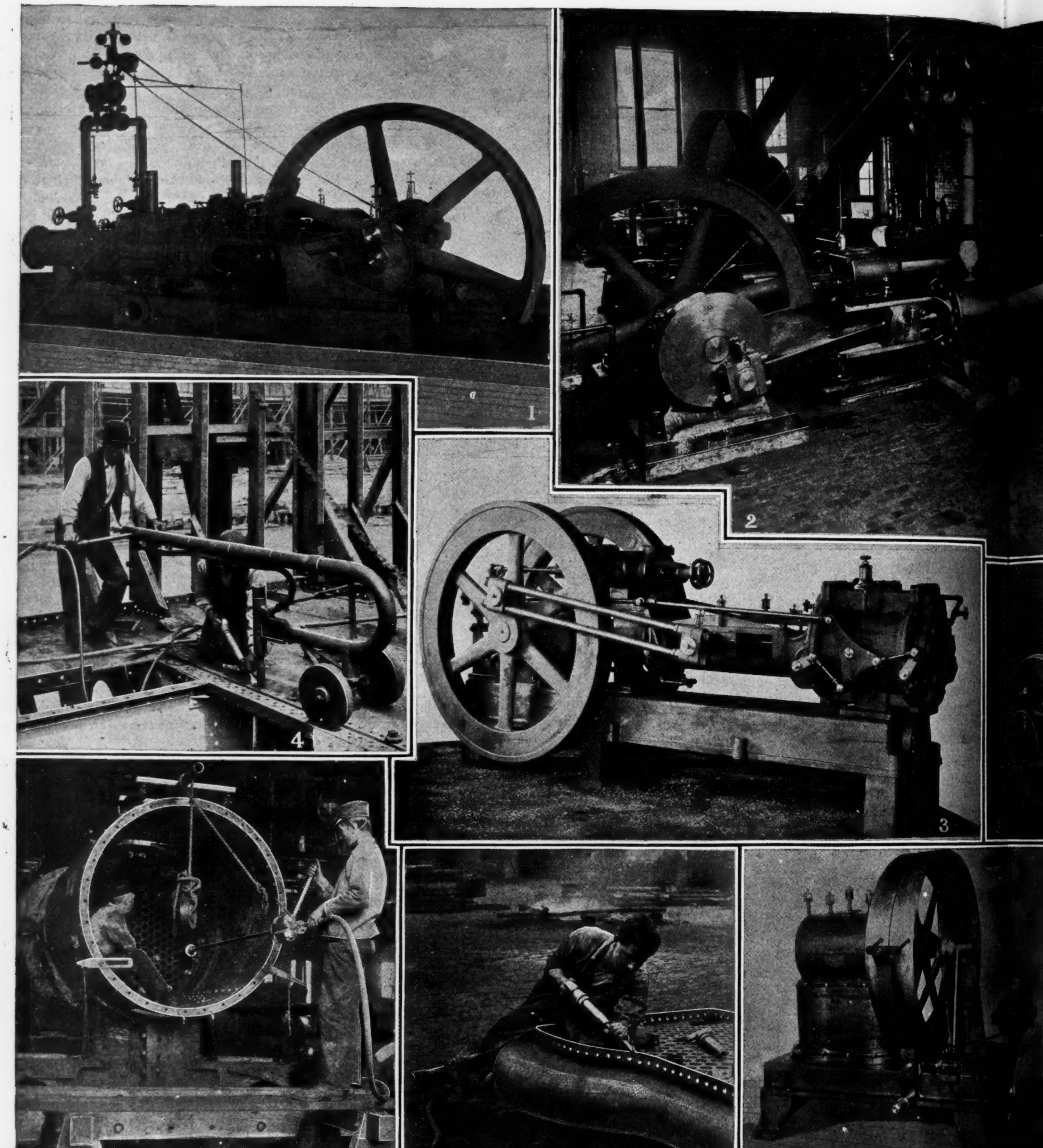
If he had been well fixed financially or his folks had cash enough to see him through, I should have said shop first, college afterward. But he wasn't and I wrote him as follows:

"Dear Nephew: After thinking over your case I should say you had better go right in the shop and stick to it. It will take three years for you to earn enough to take care of yourself, and after that—well, everything depends on yourself. If you have a taste for mechanics, and I think you have, you will like your work, get on well and in time become foreman, and perhaps reach something higher. If you go to college you will, of course, get a good theoretical knowledge, but that alone won't make you a machinist by any means, and you would have to go in the shop before you would be satisfied with yourself or any one else satisfied with you. This means three years more for you to be dependent in a measure on your mother, and you are not the boy to do that, I know.

"If you keep on with your Scranton school work that you took up at my suggestion last spring, you will have a pretty fair theoretical education by the time you are through with your apprenticeship.

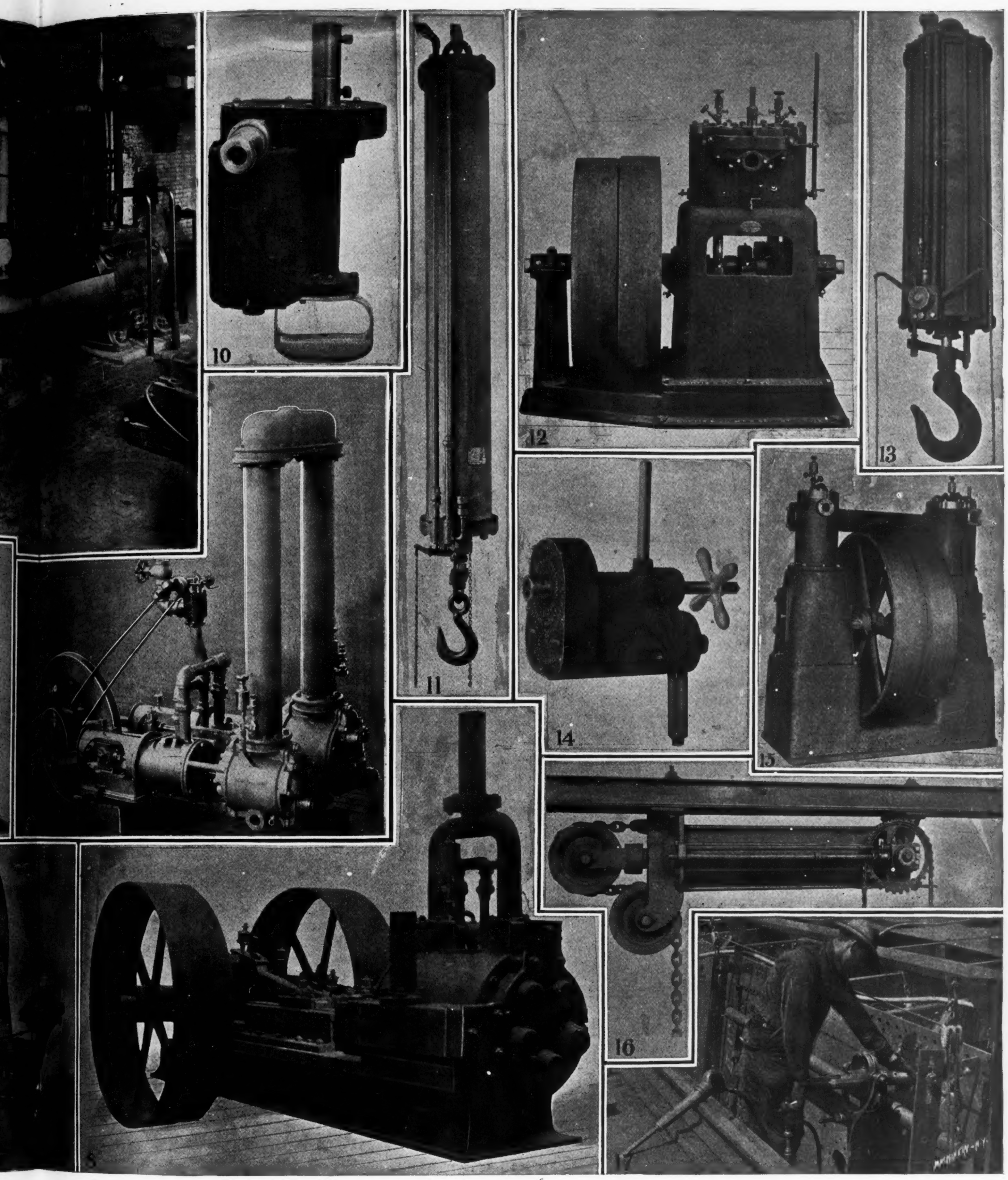
"So, you see, I advise you to go in the shop at once and do your level best. Let me hear from you often, and tell me your troubles, for you'll have them, of course. Perhaps I can offer a few suggestions from time to time, although I haven't a doubt there will be days when you'll wish you had done almost anything else. You'll get over this, though, and, I think, be glad you followed my advice. Your Uncle Ike."

He is in the shop now, and I've heard from him once or twice already.



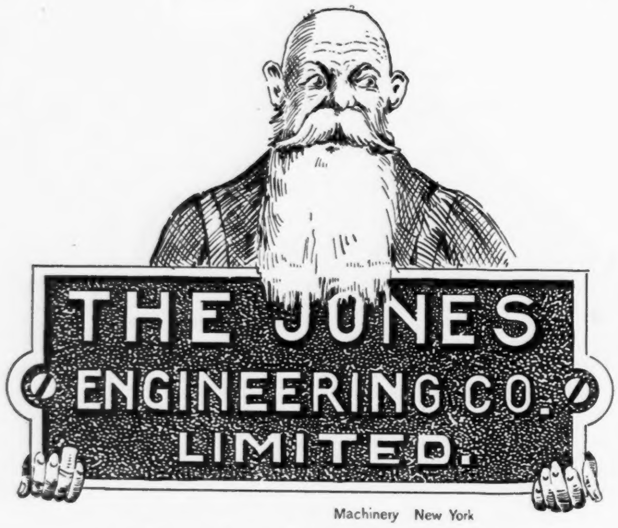
GROUP OF COMPRESSED AIR APPLIA

1. *Stilwell-Bierce and Smith-Vaile steam actuated air compressor.*
2. *Ingersoll-Sargeant direct air compressor at the plant of the Standard Mfg. Co., Allegheny, Pa.*
3. *Stilwell-Bierce and Smith-Vaile air compressor with mechanically operated inlet valves.*
4. *Riveting and chipping with Chicago Pneumatic Tool Co.'s tools.*
5. *Expanding locomotive boiler tubes with Chicago Pneumatic Too. Co.'s air driven motor.*
6. *Chipping locomotive boiler flue sheet with Standard Railway Equipment Co.'s pneumatic hammer.*
7. *Pedrick & Ayer's belt driven shop air compressor.*
8. *Clayton Air Compressor Co.'s belt driven air compressor.*



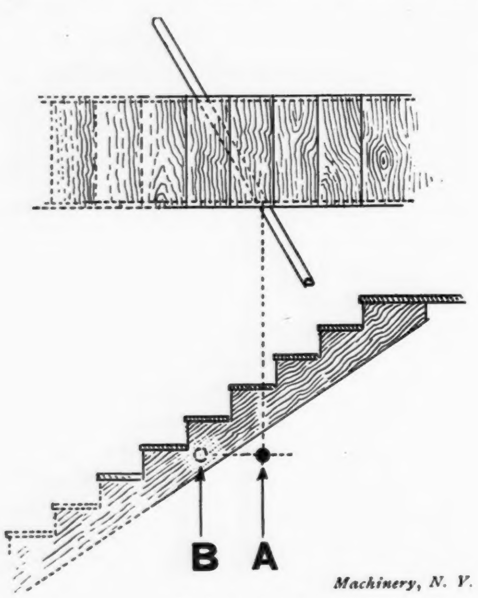
AIR APPLIANCES FOR THE SHOP.

9. *Rand Drill Co.'s steam actuated duplex air compressor with inter cooler.*
10. *Standard Railway Equipment Co.'s motor drill for wood working shops.*
11. *Pedrick & Ayer's straight lift pneumatic hoist.*
12. *Curtis & Co. Mfg. Co.'s belt driven shop air compressor.*
13. *Curtis & Co. Mfg. Co.'s straight lift pneumatic hoist,*
14. *Standard Railway Equipment Co.'s motor drill for metal work.*
15. *Curtis & Co. Mfg. Co.'s belt driven compound cir compressor with inter cooler.*
16. *Curtis & Co. Mfg. Co.'s pneumatic hoist for limited head room.*
17. *Riveting with Boyer hammer attached to Babcock-Gunnell Riveter.*



CHAPTER 4.—A LINE OF SHAFTING.

Jones had so much experience out of a contract for a line of shafting as to be worth recording. But first I must tell you about the way he bought his stock. You know that in this age no place is free from the snares and assaults of the commercial traveler, and runners for iron and steel are no exceptions to the customs of the brotherhood. Well, Smith over in Smithboro runs just the same kind of a little shop as does Jones in Jonesville. Smith, however, was never known to pay a bill if he could help it, especially a bill for stock, and he somehow managed to get all the iron and steel he wanted on all the time he needed. One day, Smith happened to have a lathe job on hand which, owing to the quality of the stock, the depth of the cut and the rake of the tool, gave a tremendous chip. The lathe was draped and the floor was carpeted with steel curls, when in came a gentleman representing So-and-So, steel merchants. He picked up a chip from the floor and said, "I see you are using our high-carbon, three-spot diamond steel, wish you would let me take one of the longest of the chips for a sample." Smith consented, telling him he would need about a thousand pounds more of the same size. That afternoon another chap with a grip dropped in and ventured an opinion that those chips came off from his hydro-carbon stock, and he also carried off a ringlet and an order for more steel, and so the good work went on. Every day some new man would come in, firm in the faith that



FIGS. 1 AND 2.

he sold the steel, and at the end of the week Smith had a year's stock of shafting engaged which he had no notion of paying for. What has this to do with Jones? Well, nothing much, only that each of these runners went straight to his shop and uncoiled a steel curl as being a sample of the stock they sold to Smith and told him that he couldn't afford to let his rival use any better stuff than he did, etc. Presently in came the man who actually did handle that brand of steel, and as he opened his grip and took out the inevitable chip, Jones jumped on him and said that he "couldn't look up without seeing one of those fellows bob up like a jack-in-the-box on the end of a long steel chip and declare it to be a sample of their stock. Gave his order yesterday to a chap just because he didn't have any pretty curls with him, and if the present agent didn't clear out he would have him arrested as an imposter; didn't believe the chip was off his stock any more than he believed the brass in his face was off the Maria Teresa."

Jones had lately secured a contract for erecting a new line of shafting in an old mill which involved several crooked turns almost like the Irishman's gun which shot around the corner. He had some notion of employing a draftsman to solve some of the problems, but he abandoned the idea when he found that he would have to pay him "as much to draft as he would to work!" So he said he "would do the drafting himself before he would hire any chap from the kindergarten school and pay him man's wages." Now, the first problem which he ran up against was to run a line of shafting diagonally under a flight of stairs, and the question was to see how high up the shafting could come and still clear the stairs. This seemed easy enough. "All one has to do is to draw a plan view of the stairs with the shafting crossing at the required angle and at the point of crossing project a line down through the elevation until it comes well below the staircase and there you have it" (see A Fig. 2). Some-

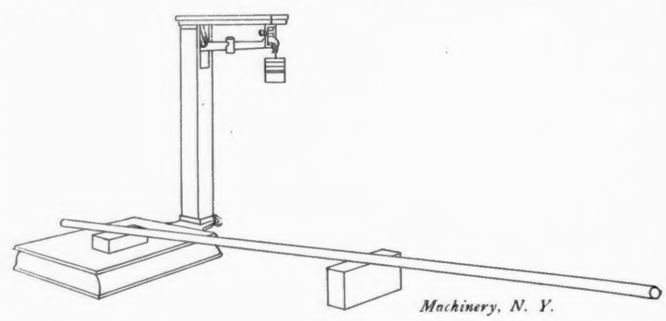


FIG. 3.

how it did not occur to Jones that the shafting crossed the stairs on the back side as well as the front, and that a line projected down from that point would cut well into the staircase as shown at B Fig. 2. They turned up shafting pretty much all that winter. Each morning the cub would go out and shovel snow from the pile behind the shop and they would bring in two or three lengths all "whiskered" with frost and icicles. The presence of so much cold metal in the shop kept the temperature down and the exhaust steam which sizzled through a coil in the corner of the shop was unable to compete with it so that everybody was glad when the shafting job was done. The contract price was by weight at so much per pound, hence the necessity of weighing

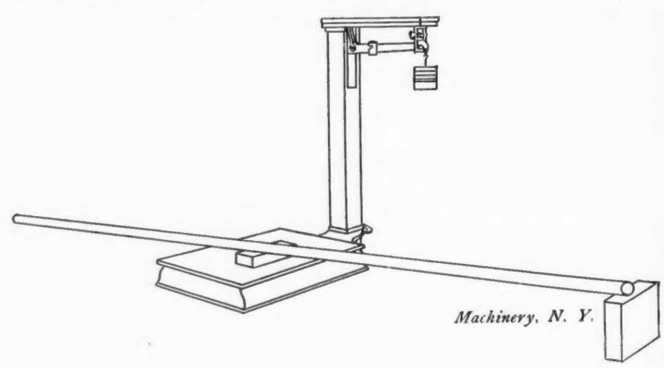


FIG. 4.

the lot. This seemed a difficult thing to do, for the only scale in the shop was one of only 400 pounds' capacity, whereas some of the pieces weighed nearly twice that amount. Jones stroked his patriarchal beard and reasoned with himself as follows: "I knew a fellar onct what had a girl so big that he couldn't reach round her, and when he hugged her he hugged as fur as he could reach and made a chalk mark, then he began there and hugged again. Now weighin' is a kind of measurin', and what's to hinder my weighin' a shaft up to a certain point and then startin' from there and weighin' the rest. Then the sum of the two must be the weight of the whole!" With this very plausible rea-

soning in mind he arranged his scale and some blocking as shown in Fig. 3 and made one draft, weighing, as he supposed, half the shaft. Then he moved the shaft along as shown in Fig. 4 and weighed the other end, added the two together and charged up that amount as being the whole weight of that piece of shafting!

In this operation he was not so far out of the way as the results might intimate. It is no uncommon thing in a railroad yard for the trainmen to weigh a car longer than the scale by weighing first one end and then the other and taking the sum of the two weighings as the weight of the car, but Jones' mistake will be readily seen on an examination of the two cuts.

W. H. S.

* * *

THE WATER WAS TOO STRONG.

The connecting rod of a high-speed engine used to drive the dynamo in a hotel at Racine, Wis., broke recently and the piece that remained attached to the crank pin knocked a hole through the frame of the machine. This is all there was to the accident and there were no serious consequences. A local reporter, however, was equal to the emergency, and prepared an "expert" account for his paper from which Mr. J. W. Fitch, of the Racine Hardware Co., kindly clipped the following extract for our readers' edification:

"The direct cause of the break-down was due to the boiler being overworked and water was forced into the cylinderhead with the result that the piston rod broke off in the middle and in the lower hull, and as it was disconnected it was thrown with great force across the room. At the time of the break-down the engine was making three hundred revolutions a minute and it was some time before the steam could be shut off. The broken arm shaft was revolving at a rapid rate and striking the floor at every turn it made a noise that resembled a cannon explosion and the guests in the entire building were startled. However, the steam was finally shut off and no damage resulted."

* * *

LOCOMOTIVE PRACTICE IN ENGLAND.

ITEMS OF INTEREST FROM THE HORWICH SHOPS.

Prof. W. F. M. Goss, of Purdue University, is contributing some interesting letters to the "American Engineer" upon some of his observations during a recent trip abroad. The second letter of the series refers to a day spent at the shops of the Lancashire and Yorkshire Railway, at Horwich, England. These shops give employment to 4,000 men and are under the immediate direction of Mr. J. A. F. Aspinall. All repairs are made here on 1,400 locomotives and the shops also build new ones besides supplying large forgings and the castings and machine work required by the different departments of the road. Dynamos for station lighting, electric signalling apparatus, telegraph instruments and many other articles which American roads obtain from outside are made here, not to speak of the fact that the plant has its own rolling mill.

Regarding the locomotive work, Prof. Goss gives an exceedingly interesting description, from which we quote the following:

It was at Horwich that I first saw the parts of an English engine, both before and during the process of erection. Very little machine work goes into the frame. Plates for the sides, an inch in thickness, two or three feet in width, and thirty feet, or so, in length, are piled and milled to bring the edges to proper outline. When thus reduced to the desired form, two plates are set up to form the sides, the cross-bracing is riveted in, castings to give bearing for the axle-box wedges are added, and the frame is practically done.

The front of the boiler is supported from the frame and not by the cylinders, as in American practice. The latter are slipped up between the frames and are bolted to the side-plates, and while easily removable, they have a very secure place provided for them, and they certainly have the appearance of being well protected and quite warm as they nestle close together. The exhaust passages are so direct that by looking into the exhaust tip one may see the slide valve. I was told that an engine coming in with broken cylinders could have the old pair removed and a new pair applied, ready for the road again, in four hours from the time of its arrival in the shop.

With the inside connection, the coupling-rod pin on the outside of the main driver is put opposite the inside crank, the wheel crank pin and coupling rod thus serving in part to balance the axle crank and the main rod. A light counterweight in the rim of the main driver is, however, necessary, and while entirely correct, it looks odd at first sight to see the wheel going with the crank and counterbalance on the same side of the center.

But I imagine that the inside-coupled engine, though it has many good points, will not always live even in England, for here, as in America, one manifestation of progress in railroading is a desire for more powerful locomotives. A response must involve larger cylinder volumes, and as no considerable increase over present maximum dimensions is possible under existing practice, the cylinders will in the end come outside of the frames.

Mr. Aspinall has succeeded in securing a high degree of uniformity in his motive power. With 1,400 locomotives he has but three different types, though the first installment of a fourth type is now being put into service. This is for heavy passenger service. As compared with those already described, it presents differences quite similar in character with those which mark recent changes in American practice. Thus, while the volume in cylinders has been increased somewhat, the most significant change is to be seen in the diameter and extent of heating surface of the boiler.

The new engine weighs, with its tender, about 90 tons, and its four coupled wheels are 87 inches in diameter. A four-wheeled truck leads the coupled wheels and a two-wheeled truck follows them. The cylinders are 19 by 26 inches, and are steam-jacketed in barrel and heads. The valve motion, like that of all other engines of the road, is the Joy, in connection with which is a steam reversing gear. The boiler, while only 53 inches in diameter of shell, presents a trifle more than 2,000 feet of heating surface, an increase of about 50 per cent. as compared with the boilers previously used by the road.

The new type of engine is steam jacketed and in speaking of the consideration which lead to this practice Mr. Aspinall explained that the service of his engines involved frequent stopping, and the hilly character of the road permitted considerable drifting without steam, both of these conditions resulting in the cylinders being more or less cooled at frequent intervals. He held that such conditions are not favorable to the compound engine, and argued that jackets, by keeping the cylinders always hot, must operate to diminish the loss arising from the cooling which otherwise occurs when steam is shut off. In response to my suggestion that jackets had been often found inefficient because of imperfect drainage, he replied that he had anticipated that difficulty and had found its perfect solution in carrying the steam supply for the large injector through the jackets, experience having shown that the injector thus supplied gave no trouble whatever.

Another detail of the new engine which was novel to me is the steam reversing gear, though I afterwards found such a mechanism to be not uncommon in English practice. Those who have used it agree that it serves its purpose excellently and is not troublesome in the matter of repairs. In principle it is in every way similar to the starting gear generally employed on various engines. A steam cylinder does the work and a water cylinder prevents shocks and a too rapid motion. As applied by Mr. Aspinall, the two cylinders are placed horizontally one above the other, but the most of those which I saw were in general appearance like a half-sized Westinghouse air pump. The apparatus is placed in a position corresponding to that of the reverse lever quadrant of the American engine. I did not see the apparatus work at Horwich, but an engineer of the Glasgow and Southwestern, whose train was awaiting at a station had evident pleasure in making me acquainted with its operation. By manipulating two small handles he moved the link by a succession of very short steps, from the full-travel position to the center, and back again to full travel. Then he repeated the operation, using longer steps, and a third time by still longer steps, and ended the exhibition by entirely reversing in a single movement, throwing the link first one way, then the other, in rapid succession, all in much less time than it takes to tell it.

LETTERS UPON PRACTICAL SUBJECTS

MILLING TROLLEY WHEELS—TURNING LINK BLOCKS.

Editor MACHINERY:

I saw a rig for milling trolley wheels the other day, and I think I can "go one better," as the one I saw only handled one wheel at a time. The fixture shown in Figs. 1 and 2 goes on a milling machine-table. Each spindle carries a trolley wheel casting A A, and is driven by a worm-wheel and a worm B, as shown in the end view in an opposite direction from its neighbor. The table is lowered for putting on wheels and then it is raised to the required height to give proper depth to the cut. By spacing the wheel blanks so that they will be a distance apart somewhat less than the diameter of the wheel, the cut can be adjusted nicely, even making allowance for wear on the milling cutters. With the milling cutter D fed in to proper depth, the worm feeds the castings around and one revolution finishes them. The two castings balance the strain on the milling spindle.

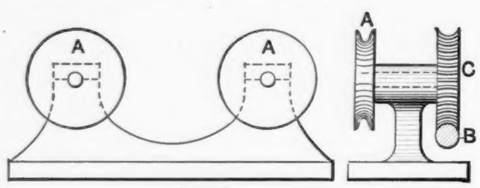
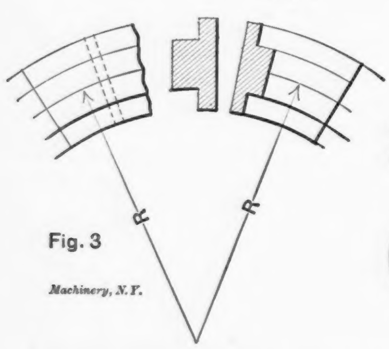


Fig. 1



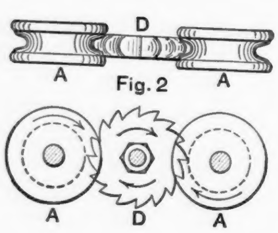


Fig. 2

We had a number of link models to make some time ago, and as the link and link-block have to be made so that they will fit perfectly, it was quite a problem to make them and not have them cost too much. The man who had the work in charge and who designed the models had evidently thought it all out however. He showed us how we could easily mill the links with an end-mill and swing the link in a little fixture of the right radius. For the link block he had an idea that was entirely new to me. He told us to turn up a ring of the right section, sort of a T shape, and of the same radius as the link that is milled as shown in Fig. 3, and then to take two milling saws on an arbor, spaced the same distance apart as the length of the link block and to saw the ring up. This gave us just as many link blocks as the circumference of the ring would allow, and they were all alike and well made, too. FRANK C. HUDSON.

Tombstone, Arizona.

* * *

TAKES EXCEPTION TO PROPOSED SHAPER SLIDE.

Editor MACHINERY:

In your October issue Mr. F. Emerson takes exception to an article of mine published in your September number on the adjustment of the gibs of shaper slides. While I do not wish to prolong a controversy that might become tiresome to your readers, I think a few words more on the subject might be allowed.

Figs. 1 and 2 in Mr. Emerson's article describe nothing new. These forms were known to the ancients and have been discarded long since for the reasons specified in my article. In Fig. 3, however, matters are reversed, and we apparently must look forward to the time when machinists will have to serve an additional apprenticeship as tinsmiths in order to learn to properly adjust their machines. To my way of thinking, any design that tends to place the adjustment of the machine parts out of instant reach of the operator is radically wrong. If the operator is not capable of looking after the proper adjustment of the machinery of which he has charge, he is incompetent. If, as Mr. Emerson states, it is necessary to protect the adjustments of some machines with a table and slide weighing probably twenty or thirty hundred pounds so that the removing and replacing of same would involve considerable expense and annoyance, to simply adjust a screw, I would suggest, as a remedy, that all adjustments be fitted with "Yale" or combination locks, the keys and combinations to be kept in the office and used only when absolutely necessary.

"A little knowledge is a dangerous thing," especially among machine designers. It would seem that some of them are inspired by the evil one when designing machine parts that should be readily accessible in case it is necessary to remove or adjust them. Take, for example, the feed-nuts on machine tools. About 80 per cent. of them become loose owing to the chattering of the cutting tool which, in some instances, causes one turn of lost motion in the feed-screw handle. In most cases, too, they remain loose, for, to reach the screws that fasten them, you will probably have to turn the machine upside down or remove a thirty hundred pound table.

Brooklyn, N. Y. T. B. C.

* * *

REMARKS BY A MACHINIST.

Editor MACHINERY:

When a machinist undertakes to make himself of more value to his employers by studying and acquiring all the information possible in his line of work, he will likely be successful and he certainly should meet with every encouragement. He may by dint of hard work grow to know a great deal more and be able to do far better work than the average workman. He may be worth possibly fifty per cent. more than any other man in the shop where he is employed. Upon realizing this, he will naturally ask for more wages. Unfortunately in nine cases out of ten, he will be met with a stony stare and receive this answer: "There is a limited sum paid a machinist; you are getting that sum and that is all you can expect. We can get all the men we want for less than we are paying you." Now this machinist gets dissatisfied, feels that justice is not being done him and gives up his job. He may have worked in that shop for a number of years, yet he cannot get more than a man who has been there only six months. He goes to another shop where he is a stranger and asks for a job. They ask what he can do and he states his ability which is above the average owing to his praiseworthy efforts to improve himself. He meets with this reply: "No, we don't need as good a man as you are. You are liable to want big wages, to be too independent and harder to handle than a man who knows less." He goes somewhere else and encounters the same thing. Then he asks himself to what purpose he studied and tramped around trying to get experience if he does not stand even as good a show as a poorer and less able man.

I once heard of a machine shop proprietor who circulated mechanical papers among his men with an evident intention of giving them an opportunity to become more experienced, and who remarked: "After a while, these men will want more pay and I shall be pleased to give it to them because they will be worth it." Bless him, I wish there were more like him. Perhaps some will say that the case I have cited is overdrawn, but I can assure them that it is not, as it came within my own observation. There are shops in the United States that would never pay a man over a certain sum, even if he were the best machinist between New York and San Francisco. Still in spite of all this, I would advise machinists, the younger ones particularly, to study and read good mechanical papers. There are plenty of these and they are cheap. Eventually, the man who makes every effort to improve himself and at the same time keeps his eye open for a chance of advancement, will succeed in bettering his position. If a man thoroughly qualified, is at some time offered a good job, he can take it and stand a show of holding it; but if he takes it and is not qualified, he makes a serious mistake, for when his employers discover that he is incompetent and discharge him, he will be worse off than if he had stuck to work which he understood. X. P. RIANTS.

ANOTHER COLUMN.

Editor MACHINERY:

I was very much interested in the article entitled "A System of Pattern Keeping," by G. H. Hall, which appeared in the October issue of MACHINERY. I should like, however, to suggest the addition of one more column on his sheet. This column is to contain the number of the sheet upon which the drawing of the pattern is to be found. For instance, the lathe bed, No. 20L—1, would be found on drawing, say, No. A—50. In this way, when a pattern is lost or broken, you know immediately where to look for a sketch of it in order to replace it. Often, too, I have found this column useful in looking up some pattern that is very seldom used, and whose general appearance I may have forgotten.

R. H. SMITH.

* * *

ODDS AND ENDS FOR THE SHOP.

Editor MACHINERY:

Often in counterboring for large flat-head screws, particularly in hard brass, the counterbore will chatter badly. This is very easily remedied by grinding the counterbore with the least possible clearance at the heel. If a very smooth job is wanted, the clearance may be so slight that the tool has to be forced slightly to its work in order to cut at all. Counterbores so ground will not only start holes smooth but will true up those that have bad chatter marks. This is an old method often used with planer-finishing tools, and may be applied to any broad cutting edge.

In many shops the twist drill has so replaced the flat drill, that the younger boys seldom if ever have seen the latter; yet when a hard piece of steel is to be drilled, a flat drill tempered as hard as it will stand and ground with rather small clearance at the heel—though enough to cut freely—and as thin at the point as will stand the crushing and twisting action, will generally cut metal that cannot be touched by a twist drill. Kerosene often makes a better lubricant for such work than the heavier oils.

Often a twist drill may be ground flat and parallel with the axis for a short distance on the front side of the flute, and as it resembles a flat drill somewhat in appearance of the cutting edge, it will also cut harder steel than as usually ground. It should also be ground thinner than usual at the point.

Twist drills have their field more largely, however, in the regular line of work, and are not hard enough for such uses as the above.

Once in a while it is convenient to drill glass, and this may be done by scratching a little cross in which to start the drill, using a very hard flat drill ground thin at the point, a steady but light feed and rather slow speed. Benzine is the lubricant. A block of wood ought to be used between the glass and drill-press table.

In drilling hard steel and other hard substances, the feed should be strong enough to start the cut at once and keep it up, for when a drill rides over the surface for a very few revolutions, the edge is worn off, and the work so glazed that cutting action is very hard to start again.

Drillmakers and others call the attention of users to the matter of thinning down the points of drills, as they wear shorter and consequently thicker, but, in most shops, this is neglected. If this thinning down the points of drills were always the practice, the ease and rapidity of drilling would be a very great surprise to many.

Soldering articles of steel is very common; but it is rather strange that a good preventative of rusting, after using zinc chloride, the ordinary soldering "acid," is so little known. It is simply to dip the work in sal soda solution, the common "soda water" of every shop, after the soldering is done. This also prevents those rust marks so often found on tools and work one has been soldering when the hands are not dipped in the soda water or rubbed with a piece of waste wet in the solution.

The solution may be cold or warm as convenient. Also in soldering or "sweating" steel it is frequently desirable that the surfaces of the joint shall not rust. This can be accomplished by using the acid as is generally done, and by thoroughly tinning both surfaces, then washing them in sal soda and then in water. This last is very important as solder will not flow well in the presence of sal soda.

After washing off all sal soda the surfaces may be brought together, heated and united; for the solder has already adhered to the steel, and the two surfaces of solder will, of course, unite when heated; and if the acid has been well neutralized by the soda, no rusting will occur. A stick is often used for covering the surfaces with acid, but it soon becomes charred and gummy and causes annoyance.

A slate pencil is much better than a stick, and where the work is itself heated, instead of using a copper, a strip of brass may be used to carry the acid and lead it and the solder where desired. The brass even when not tinned at first soon becomes tinned and is very efficient in doing a good job.

FREDERICK M. BUSH.

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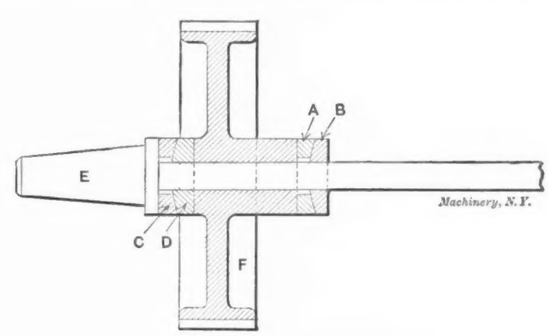
CUPPED WASHERS FOR HOLDING WORK IN GANGS.

Editor MACHINERY:

Here is a device which may perhaps prove of interest to readers of MACHINERY. It is used for holding a gang of gears, or other similar work, true on an arbor without the aid of finished hubs or surfaces for clamping. It saves the expense of these operations and at the same time guarantees true work. It may prove of special interest to those who have to finish work that can be mounted in a gang on an arbor and that does not require that the sides or ends of hubs be squared except for clamping. It consists of cupped washers which lie between the hubs as shown in A, B, C and D in the sketch. The washers are made to adjust themselves to any irregularity on the surface of the



ARBOR FOR GEAR CUTTING.

hub by reason of the spherical construction without distorting the truth of the work with its bore and to keep the arbor true by giving an equal pressure all around the face of the hub when the nut is set up. The holes in the washers are 1-16" larger than the arbor so as to give them the necessary freedom to adjust themselves.

I have used these cupped washers successfully on gears, mounting them in gangs of six on an arbor, for cutting the teeth. The hubs of these gears project beyond the rim on one side and the rims of each are 1⅛" wide with forty to eighty 7-pitch teeth. Of course, one set of cupped washers answers for all sizes.

Another device used with success for holding gears while cutting teeth consists of light discs which lie between the gear rims and heavy rigid ones which brace and clamp the rims while the teeth are being cut. A coarse feed can be used without springing the rims forward or the arbor down out of a true line, both of which troubles are sometimes experienced when cutting a gang without discs. Below are a few figures on speeds and feeds of milling cutters that show two methods of practice in different shops. The teeth of a gang of six 120 teeth gears, 7-pitch, were cut, the surface speed of the cutter being 6" per second and the feed of the platen carrying the gears being 1" in one and a half minutes. It required 3.7 days to cut the gang of six gears under these conditions and the cutter was sharpened twice for each set as it would dull before all the teeth were cut. Gangs of six 120 teeth gears can be cut with surface speed of cutter 4" per second and platen feed of 3" per minute in nine hours the cutter being sharpened but once for each gang. Note the result of the two methods: Six gears cut in 37 hours and cutter removed, sharpened and reset and the same number of gears cut in 9 hours, the cutter being sharpened only once. Experience goes to show that a coarse feed with comparatively slow speed of cutter dulls the cutter less rapidly and is more effective on some classes of work than a faster speed with lighter feed.

"JACK."

ABOUT THOSE EXAMPLES OF MANUAL TRAINING.

Editor MACHINERY:

When I wrote the letter on manual training that appeared in the August issue of MACHINERY, I had not the slightest intention of criticising the manual training school as an institution. These schools are doing a great deal of good, and I should be the last to advocate their abolishment. But what I did wish to bring out was the fact that far too many of them are not doing the good they could do. Since reading Mr. Buchanan's "metaphysical" tirade, I have gotten out my August paper and carefully reread my article, and I must say that I can find nothing in it antagonistic to the schools themselves. I did, and I do criticise some of the teachers employed in the schools, and also some of the methods. To be specific, let me quote some passages from my letter: "If a thorough training in this kind of work is impossible under the present school systems, then the systems ought to be changed and something else sacrificed instead of the most important subject in the whole course. * * * If the boy.... is required to work a large number of practical drawing-room problems, he should have no difficulty when he gets into the machine shops. I have * * * in almost every case noticed the same defect—either an inadequate training or a woeful lack of confidence. Both of these faults can and ought to be remedied in the schools."

Do these passages appear antagonistic to the idea of a manual training school? Do they appear as if I doubted that "thoughts are beginning to be recognized as forces?" But perhaps some one of unusual psychological penetration may avow that my mind is in a "negative condition" concerning the manual training teachers.

I know it to be a fact that many of our manual training schools have teachers of metal-work, wood-work, forge and foundry practice, and drawing, who never earned a dollar at the trade in their lives; and what is more, they could not hold a position as journeyman a week. Such men, with their second-hand knowledge of machine-shop practice and management, derived from books, do not seem to realize the importance of practical, every-day problems for the student. The application of the principles of geometry or trigonometry to some problem not only tends to fix the mathematics in the mind, but prepares the mind for similar problems that it will be called on to solve in actual business experience. But "a practical mechanic," of course does not need to be told this.

I do not know whether the manual training schools, as a rule, require all candidates for positions in their work-shops and drawing-room to have had any experience in the trade they are to teach, but I do know that enough of them omit this requirement to warrant my speaking of it. I see no reason why this experience should not be made a necessary and indispensable condition for all such candidates. If a man is not sufficiently interested in the subject that he is going to teach to submit to the drudgery (if he considers it such) of at least a year in a shop or drawing-room, then, I say, the school is better off without him. For in no other way can a man become so familiar with and have such a comprehensive view of machine-shop methods as by actual contact with them.

I think that graduates of many manual training schools do no better in a mechanical line than they would were they to receive their education in the cheaper, ordinary English high school, though this ought not to be the case. Their success is not due to their manual training, but to their general education. Just so, the statistics, excellent in their way, furnished by Mr. Buchanan, do not prove the superiority of the manual training graduate over the man of equal education, but over ordinary workmen; and I take that to mean men with less than a high school education. Statistics, I believe, are not to be had on the point that I wish to make, for they should come, not from the employer, but from the foreman of the work-shop or drawing-room. He is the only one who can tell how much direct good the manual training has done in preparing the student for immediate work. The average wages paid the manual training graduate, during the first six months of his service, would also tend to fix some kind of standard of judgment.

Of course I do not know any of the methods employed by Mr. Buchanan in his teaching, but I will say, that in so far as he neglects to give his students, in one way or another, a thorough drill in actual drawing-room problems, such as, calculating the speed and diameters of pulleys and gears, the weight of irregular bodies in cast iron, wrought iron and steel, the angles for bevel gears, etc., just in so far is his instruction inadequate, and conducive to a lack of confidence in the student. Since it appeared a matter of regret that my address was unknown, I herewith append it.

R. H. SMITH,
29 Benevolent street, Providence, R. I.

* * *

JIG FOR SHAPING LOCOMOTIVE ROCKER ARMS.

Editor MACHINERY:

Having noticed in a number of your recent issues, articles on shapers, perhaps it may not be out of place to give you a sketch and a few words of explanation regarding a unique jig for shaping the round part of the arm of a locomotive rocker.

Originally these arms were milled off, but as the only available miller was a large and expensive machine which could be used

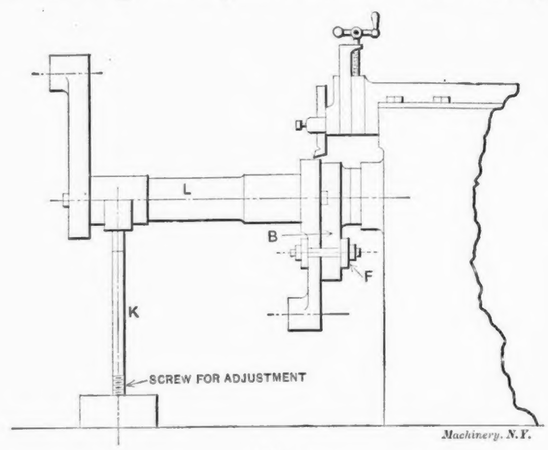


FIG. 1.

to better advantage on other work, the arms were transferred to a slotter. Here, however, trouble was also experienced. The head had to be raised to such a height that only a very short stroke could be obtained. Much time, and consequently money, for time is money in any machine shop, was consumed in adjusting the machine and setting up the work; a slotter is also an expensive machine for that class of work. The jig shown in Fig. 1 was devised and the work was transferred to a shaper. The advantages of this jig are first, its rigidity; second, the ease with which work can be attached; third, only one nut to tighten

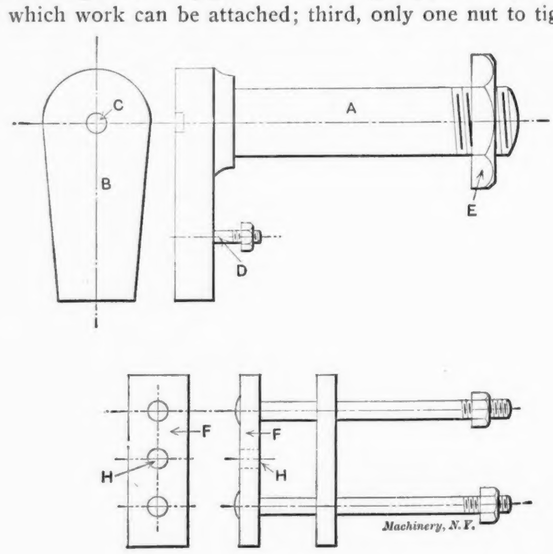


FIG. 2.

in "setting up" jig; fourth, the small amount of room taken up by the jig, which can be left on the machine without being in the way of the machinist. All the work done in these shops is piece work, and as the rockers are now finished for fifteen cents per rocker cheaper than before, you can draw your own conclusions regarding the efficiency of this jig.

The shaper to which this jig is attached has the revolving feed attachment. The spindle A on the jig, Fig. 2, fits into the hole in this feed device and is fastened on the inside by a nut E. In the arm B of the jig and in line with the center of the spindle, a

hole $1\frac{1}{8}''$ in diameter and about $1''$ deep, is bored. This is used as a sort of female center into which a male center C on the rocker arm fits. This locates the position of the rocker and insures a uniformity in the various rockers. On the back of the arm B a $\frac{3}{4}''$ stud D is fastened, which goes through a hole H in the carrier F, and which holds it firmly in place. It is not necessary to remove the carrier to place a new rocker in position. A hinge in place of one of the nuts on the carrier would simplify it still more, but as all the arms are not of the same thickness this is impossible, or at least not advisable. To support the weight at the extreme outer end of rocker a light stand is used as shown in Fig. 1 at K.

A jig of this kind, as can be readily seen, is very rigid and a cut $\frac{1}{2}''$ in depth with $\frac{1}{8}''$ feed can be readily taken. H. H. D.

* * *

ONE USE FOR MAGNETISM.

Editor MACHINERY:

In manufacturing a machine we have an operation of doweling to the machine a small piece, where it is necessary to drill almost into a bearing in order to get sufficient stock to support the dowel pin, and also to ream the hole so that the dowel pin will fit nicely.

The drill is 3-32″ in diameter, the hole, when drilled 9-16″ deep. It was necessary to turn the machine over after drilling the hole to prevent any of the chips getting into the working parts. The operation was carried on as follows: The hole was first drilled as near the bearing as was safe, then the machine (weighing about 30 pounds) was lifted and turned over, so that the chips would fall out, then placed back on the drill-table and the hole reamed to size.

It was not many days when the workman said he thought he would have to give up the job as he noticed that every time he lifted a machine in the air to clean out the hole, he felt a pain under his right arm. Wondered if he had not better see a physician, fearing he was contracting a cancer.

I told him to wait a little while and in the meantime magnetized a drill $\frac{1}{64}''$ in diameter smaller than the one he was using. After he had drilled a hole the full depth, I told him to carefully brush the chips just away from the drill, but not enough to get any of them into the parts, then remove the drill and twist the smaller one I gave him, by hand, in the hole. He was surprised on removing the drill to find nearly all the chips attached to it, leaving the hole sufficiently clean so that it could be reamed without lifting the machine from the table. I have heard nothing more about the cancer. I trust this may be of interest to some of your readers who may have just such an operation to perform or perhaps one even more difficult. E. C. THURSTON.

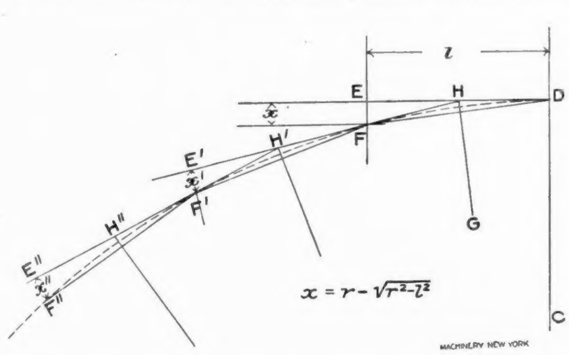
Providence, R. I.

* * *

TO CONSTRUCT A CURVE BY POINTS.

Editor MACHINERY:

The accompanying diagram and description will be found useful for laying out a curve having an inaccessible center or one whose radius is too long to be accommodated on the drawing-board. When the radius (r) is given, and any cord (l) is assumed, to construct a curve by points proceed as follows: First



find x by formula above. Draw line C D, and at right angles to it the line E D = l. Through E draw the perpendicular E F, and make it equal x (marking the first point in the curve) at F. Join F D and bisect it in G; through G draw the perpendicular G H, intersecting the line E D in H, and through F and H draw the indefinite line H F H′ E′, making F E′ equal to l. Erect the perpendicular E′ F′ equal to x, and locate F′, which is the second point of the curve; proceed in the same manner for other points of the curve desired.

Hokendauqua, Pa. GEO. H. WALTMAN.

* * *

TESTING AND ADJUSTING ENGINE LATHES IN GERMANY.

Editor MACHINERY:

We, as a rule, determine a lathe by its height of center over the bed and length between the centers or the whole length of bed.

The old style German lathe with a wide bed and the carriage built way out so as to enable the engineer to turn a piece of work as big as the gap in the bed of the machine allows, has seen its best days, and a good mechanic with a little common sense will not build a tool to turn a needle bar of a sewing machine as well as a locomotive tire.

The main thing in a lathe is that the proportions of headstock and bed, as well as carriage and headstock, correspond with each other, and in order to do a good piece of work, it is absolutely necessary that the alignments be as near as possible.

First, after getting the castings, we rough out the bed on a milling machine with a gang milling cutter. This done, we plane the ways on a planer, then drill the holes in the bed and set the bed on its feet. We then scrape the ways for the carriage and tail stock straight and parallel with each other before touching the carriage at all. The head and tail stock are bored out together in one setting and then, after being driven on a special arbor, they are planed together.

We now fit in the bearing boxes and scrape in the spindle to a good fit. The spindle is ground outside as well as the taper part of the hole inside the spindle. This done, we fit on the carriage to the bed, then put on the headstock and test the latter to see if it is parallel with the bed in the horizontal as well as the vertical plane. This is done in the following manner:

Take a piece of steel pipe about $1\frac{1}{2}''$ outside diameter and fit a taper plug in one end and a piece of flat iron in the other; then turn up this bar carefully in a true lathe and grind it the whole length, not allowing any limit in diameter. Put this bar in the spindle and try it at the outer end by setting an indicator, as built by the Brown and Sharpe Mfg. Co., under the bar so that the needle on the indicator will bear against the bar. Then revolve the spindle with the bar inserted and should the test-bar run out, divide the difference between the readings of the indicator by two. Now, put the indicator under the bar at the other end and take the difference of the readings. The difference found between the average readings at the inner and outer ends of the bar gives the amount by 50ths of millimeters, as the graduation on the indicator shows, which the spindle in the headstock is out of line with the ways on the bed. Try in the same manner how the spindle lines up with the bed in a horizontal plane by putting a stop-piece on the base of the indicator and holding this against the edge of the carriage so that the indicator needle touches the test-bar sideways. As the ways on the bed are straight, we do all the correction on the ways in the headstock. After the headstock is scraped to the bed and parallel with it inside a limit of about 0.01 mm. in 18″, compare the height of the head and tailstock with the indicator under the test-bar, then take the bar out, put it in the spindle of the tailstock, move the carriage with the indicator attached under the end of the test-bar nearest the spindle, thus finding the difference between the head and tailstock in height. Sideways, use the stop under the indicator and move it back again, testing the alignment as when measuring vertically.

Next, make the ways of the cross-slide square with the spindle in the headstock. To do this, take a taper plug and fasten on the outer end of it a bar of flat iron about $1\frac{1}{2}''$ wide and several inches long. This bar is fastened to the plug with a set-screw and is slotted so that it will be adapted to different swings. On the outer end fasten a pointed screw by putting it through a threaded hole in the end of the flat iron piece. Then take a piece of cast iron, square on one side, the other side the same bevel as the cross-slide bed. Move forward the spindle with the plug and bar in place and set the screw so that it just touches the piece held in the ways of the cross-slide. Then turn the spindle backwards and manipulate the same way as on the front end of the machine. The difference in the touch of the screw

will show how much the cross-slide is out of square with the spindle. All correction is done in the ways of the carriage.

FRANK SALMON,
With Schuchardt & Schutte, Berlin.

* * *

METHODS FOR CENTERING CYLINDERS FOR FACING AND TURNING.

Editor MACHINERY:

For centering and facing off the ends of large, rough cast cylinders and similar pieces a device was used by one of the prominent firms of this country engaged in the manufacture of heavy machinery, which proved very convenient and reliable.

A cast iron cross was made, as shown in Fig. 1, with an adjusting screw tapped into the end of each of the four arms, the ends of the screws being pointed so as to fit into four corresponding centering holes made in the casting.

In the center of the cross a hole 1½" in diameter and 1½" long was drilled, into which a steel, oil hardened center was fitted, so that there would be no getting out of line on account of wear.

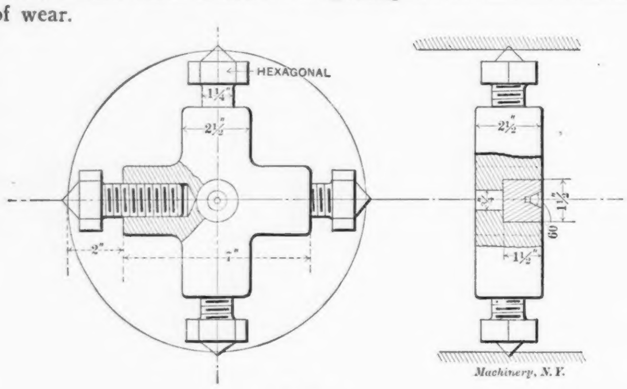


FIG. 1.

A smaller hole was continued through the casting so as to be able to replace the steel center in case it became necessary. These crosses were made so that they would take cylinders with a variation of bore of three inches. For the facing off and turning of cylinders that had been already bored a device as shown in sketch Fig. 2 was used. By means of this device a great deal of time was saved in the centering of the work. The device consists of a cast iron disc turned to a diameter a shade smaller than the size of the bore of the work to be faced or turned. This disc was cored entirely through with the exception of a thin connecting piece on either side.

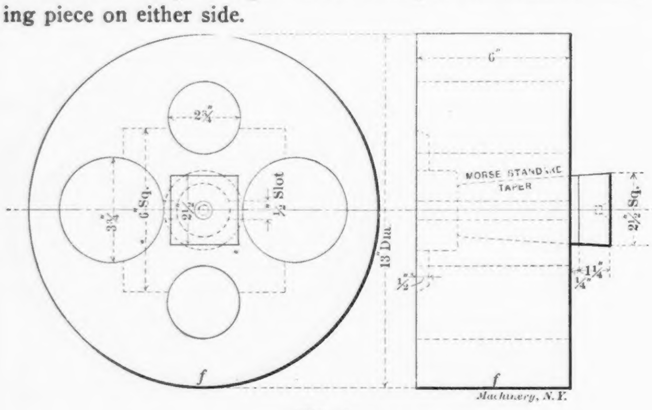


FIG. 2.

In the center of the disc was bored a taper hole, to which was fitted a tool steel center piece, countersunk on one end to receive the center of a lathe.

After the disc had been placed into position in the work, these tapered center pieces were driven into the hole to receive them in the disc, just tight enough to spring the sides of the disc out and thereby holding it firmly in the cylinder.

The ends of the steel center pieces were made square so that a wrench could be applied to remove them from the discs.

The discs were countersunk on the inside face to hold a stick of timber which was placed between the two discs in either end of the cylinder to prevent them from closing in after the work was swung in the lathe. A. DUNN.

Denver, Colo.

BELIEVES IN CLOSE FIGURING.

Editor MACHINERY:

In the October, 1899, issue of MACHINERY there appears an article on the subject of "A Blow-off," by W. H. S., under the heading "Jones Engineering Co., Limited." I desire to state that W. H. S. is slightly wrong in his conclusions, as the accompanying reasons and drawings will show. Fig. 1 is the blow-off before Jones changed it, and Fig. 2 illustrates the changes Jones made. It illustrates the criticisms and also explains why the blow-off "popped" at 80 pounds instead of at 100 pounds.

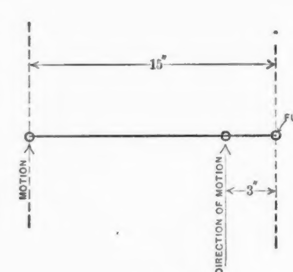


FIG. 1.

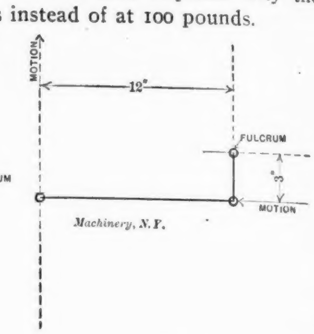


FIG. 2.

I agree with W. H. S. as to the rule by which he reasoned but not as to the application of the same, since the direction of motion is not as his diagram shows, but rather as shown in Fig. 3. The directions of motion of any point in the circumference of a circle is always a tangent to that circle, and a tangent to a circle is always at right angles to the radius at the point of tangency.

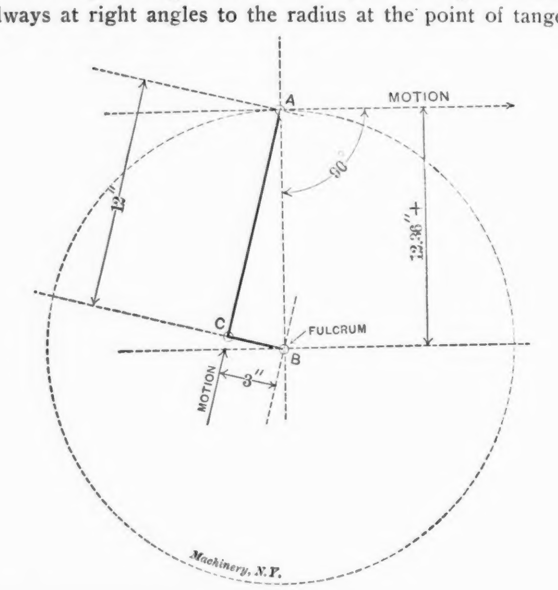


FIG. 3.

In Fig. 3, B is the fulcrum, C the leverage applied, and A the weight. A C is perpendicular to C B, therefore A B is the hypothenuse of a right-angled triangle with a length of 12.36". Thus, we find that the lever, instead of giving an even multiplication of 4 to 1, is in the ratio of 4.12 to 1 or nearly 4⅛.

I am a firm believer in earnest and friendly discussion as it is of interest to many and doubtless brings up many new points and benefits all who take part therein. JAMES B. LUND.

Austin, Ill.

* * *

The Delaval steam turbine, which is of Swedish origin, is now manufactured in Great Britain, the home of the Parsons steam turbine, which already has an enviable reputation in that country. The Delaval turbine is of the impulse type and has a number of nozzles so constructed that the steam is expanded to the terminal pressure in passing through them to the vanes of the turbine wheel, beyond which point there is no further expansion. The wheel of a 100 horse-power Delaval turbine is about 20 inches in diameter and runs at about 13,000 revolutions per minute. In the Parsons turbine, on the other hand, there is a series of turbine wheels, with guide vanes between. Steam is delivered to the first wheel at boiler pressure and expands a small amount in passing through the first wheel. It then goes through guide vanes to the next wheel and expands a little more in passing through this wheel, and so on, the expansion being by gradual steps as the steam goes from wheel to wheel.

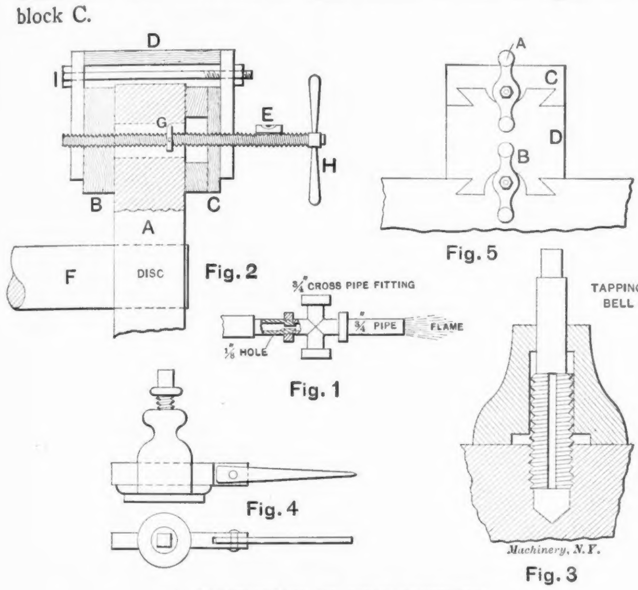
SHOP KINKS.

A DEPARTMENT OF PRACTICAL IDEAS FOR THE SHOP.

Contributions of kinks, devices and methods of doing work are solicited for this column. Write on one side of the paper only and send sketches when necessary.

SOME PENNSYLVANIA SHOP KINKS.

U. P. Lang, of Meadville, Pa., says: I recently had a job of boring out and putting in two crank pins which, after being pressed in, would not remain tight. The pins were 4" in diameter in the crank disc. I rebored the hole and heated the disc by running a hose from a natural gas jet and heating as much as was possible with only a black heat. The gas heater is shown in Fig. 1. I allowed only 4-1000 so as to be able to slip the pins in without sticking. They have been in place over two years and have no appearance of ever working loose. Accompanying this is a rough sketch (Fig. 2) of the tools I used to rebore the disc. This was my own way out of a rather difficult job, but the idea is probably old to most machinists. The boring bar is finely threaded, has the cutter G, and is held in position by the wood blocks B, C and D. By trying level E when the crank was at each center and at the top and adjusting the bar so that it showed the same at all three positions, and was central with the hole, I knew that the bar was parallel with shaft F. The cutter bar was threaded in split block B and a tight fit in block C.



A COLLECTION OF SHOP SCHEMES.

Fig. 3 is the sketch of a handy arrangement for tapping holes. The tendency of the tap is to remain square with the face of the work when supported by the bell-shaped stand. When the tap has been started the bell is slipped off and the tapping finished in the usual way.

I have noticed that very few lathe hands have a pointer for their post. They generally use a pair of inside calipers when they are setting stock for tapers but the device shown in Fig. 4 will be found more convenient. When cutting long threads it is difficult to get a light cut after running the carrriage back. With a double or swivel carriage this can easily be done. When starting a thread keep the handle B, Fig. 5, straight and feed in with handle A. When you get to the end of the cut pull out with B leaving A stationary. When ready for the cut again, bring B straight as before and feed again with A. Be sure to have the slides C and D parallel when using this scheme.

When facing off work if it is desired to take a very fine cut, as in cutting off piston rings for instance, put the slide C at a slight angle with D, cross-feed with B and side-feed with A.

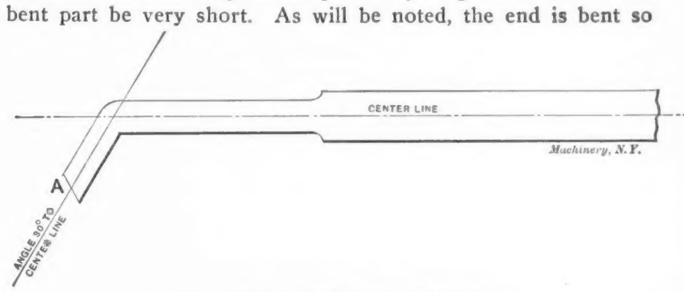
Speaking of piston rings, use a 3-16" wide parting tool for cutting-off and when nearly through take out the tool, insert a narrow side tool, face the inside of the cut, gauge and cut-off with the point of the side tool. This makes both sides true and although it takes longer to do the lathe work, saves double the time when fitting up.

A piston ring is a mighty hard thing to fit just right so as not to be too tight nor too loose. If it be too tight it will do no good; if too loose it will click. To prevent clicking try pening slightly with a light hammer in the middle and near both ends, always pening on the one side of the ring so as to stretch that side longer than the other. This will give the ring a twist or bow, which can be plainly seen if laid on a flat surface. This forms a warped surface, so that when the ring is in position it has a tension sideways which will remain about the same although the ring may wear considerably in the groove.

The way to pene a flat thin ring is on the inside, near one edge. Pening it thus will cause it to spring in the same manner as in the previous case and accomplish the same result.

AN INSIDE THREAD TOOL.

"E. J. B.," of Dubuque, Iowa, sends a sketch of a handy form of inside threading tool that is easy to make and grind. It can of course be used only in comparatively large holes unless the bent part be very short. As will be noted, the end is bent so

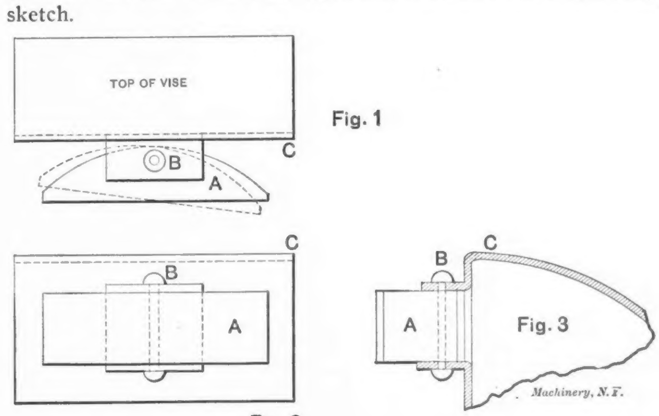


EASILY GROUND INSIDE THREAD TOOL.

that its center line makes an angle of 60° with the center line of the shank. By making it in this manner, it is necessary to grind only the outer side of the point which is often a convenience when the wretched condition of the grinding apparatus in many shops is considered.

VISE JAW FOR HOLDING TAPERED WORK.

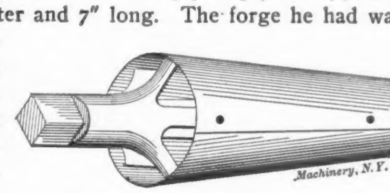
Wm. F. Torrey, of Roxbury, Mass., writes that the other day, in going through the shop of a large pump manufacturing company, near Boston, he noticed a shop kink that was new to him. Thinking that perhaps it may be new to some readers of MACHINERY also, he sends a description of it with the accompanying sketch.



The device is for holding tapered work in a plain vise and consists of a piece of sheet steel (C) cut and bent to fit the jaws of a vise. In the middle of the vertical side, cuts were made and two ears were bent out to form sides, then a hole was drilled for a rivet (B) to hold the swing jaw (A) in place. The jaw adjusts itself to the taper of the work. The device was used for finishing light work. Fig. 1 is a plan view. Figs. 2 and 3 are side and end views.

HARDENING TAPS.

L. B. sends in a kink for hardening taps. He says that, some time ago, he had to temper two standard pipe taps, one 2⅛" and the other 2⅜" in diameter and 7" long. The forge he had was rather small for the purpose and the body of the tap was heavy with a very fine thread, so that it was quite difficult to heat thoroughly without burning the teeth. Besides this the work had to be done without delay. He took a piece of tin, wrapped it around the threaded part of the tap and riveted it on both ends as in the sketch, and then heated the tap in the tin case until the flutes cast no shadow, when the tin case was shoved off the



PROTECTIVE SHIELD FOR TAP.

tap. The tap was then allowed to lie in a still fire but was turned at intervals until it became thoroughly heated, when it was dipped the same as any other tool. Some people, L. B. adds, would have used bushings or a piece of pipe instead of tin, but that would have taken much longer. The pipe arrangement is all right when the temper of a tool is to be drawn.

FROM DOWN IN TEXAS.

Mr. Harry Gunther, of the San Antonio Machine & Supply Co., San Antonio, Texas, mentions in a recent letter that while in a Mexican blacksmith shop he noticed that the blacksmith was making some bridal bits and horse spurs of Norway iron, and punched the holes in the iron while it was cold, just as a blacksmith ordinarily does in hot iron. He says that while this may not be new, he had not appreciated that Norway iron could be worked in this manner, and perhaps the idea may be of benefit to others. As another instance of this he mentions seeing a die sinker making dies for ticket punches by making the punch first and then driving it 1-16-inch deep into a piece of cold Norway iron ⅛-inch thick and then filing off the back of the iron so as to expose the hole, afterwards hardening the die with prussiate of potash.

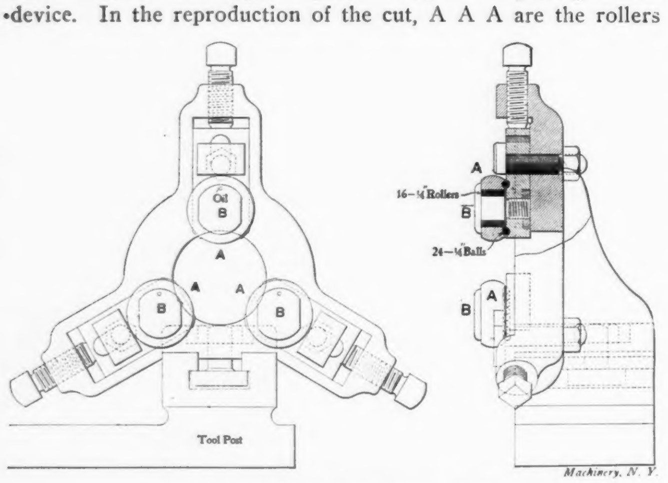
* * *

ITEMS OF MECHANICAL INTEREST.

NOTES GLEANED FROM OUR CONTEMPORARIES.

A PISTON ROD ROLLER.

In the July issue of MACHINERY we illustrated three forms of burnishers or rollers that are used extensively in railroad shops for finishing bearings or piston rods and valve stems by a rolling process. As pointed out at that time the practice is becoming very popular and deservedly so on account of the excellence of the surface obtained and the cheapness of the process. "Locomotive Engineering" illustrated one of these burnishers in a recent issue, which is made in the form of a solid steady-rest and intended exclusively for piston rods and similar work which has no section too large to pass through the opening in the device. In the reproduction of the cut, A A A are the rollers

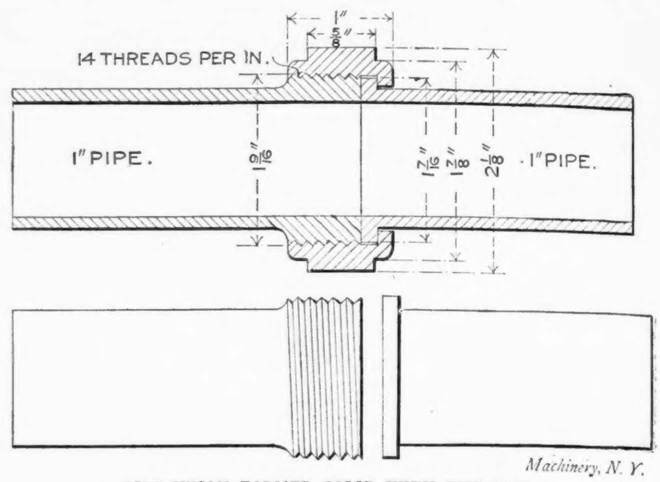


BURNISHING TOOL FOR PISTON RODS.

mounted on the pins, B B B, which are screwed into blocks fitted in the grooves of the frame of the tool. As will be noted the device follows in its details the familiar features of the steady-rest, the adjustment being made by the three screws, after which the blocks carrying the rollers are tightened to the frame by the clamping screws. The rollers, A A A, turn on roller bearings as indicated, there being 16 rollers ¼" in diameter in each bearing. The side-thrust which is considerable in these tools is taken up by 24 balls ¼" in diameter which lie between the roller and the frame. As is evident, the device is mounted in the tool-post of the lathe when being used and carried along by the carriage feed.

A NOVEL FORM OF PIPE UNION.

The "American Engineer" recently illustrated and described a form of pipe union that any one will concede to be desirable but not always feasible. It was devised by Mr. Brown, master mechanic of the Pennsylvania railroad shops at Altoona, and as will be gathered from the following description, the union is solid with the pipe, being swaged while hot in dies on a bolt header. In each case the external die is formed to the shape of the finished piece. The internal die consists merely of a plunger of two diameters, the larger representing the larger diameter of the union and the smaller diameter corresponding with the inside diameter of the pipe. The dies are so made that before any upsetting takes place on the pipe the internal die has entered the external die in such a way as to form a closed or solid die. This method permits of the use of the next smaller size of standard union nut than would be used with the standard union. For

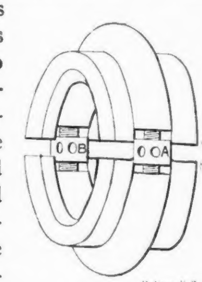


PIPE UNION FORMED SOLID WITH THE PIPE.

example, for a 1" union made in this way a standard nut for a ¾" union may be used. These unions are very simple and neat and they possess the advantage of reducing the number of joints and opportunities for leakage, as well as making a very strong joint.

AN ENGLISH SPLIT COLLAR FOR SHAFTS.

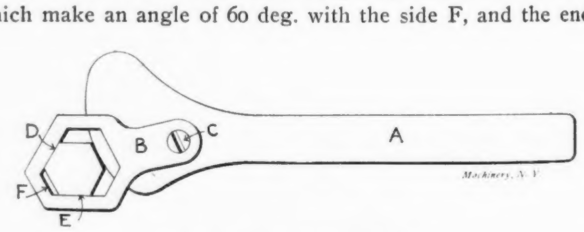
A desirable form for collars on shafts is shown in the accompanying cut. As will be noted it does away with the dangerous set-screw and is entirely free from all projections. It also has the advantage of being applied without difficulty in any ordinary position without necessitating the uncoupling of the shaft, as it is split in two parts and held together by two right- and two left-threaded screws, A and B. This construction enables a vise-like grip on the shaft to be obtained, does away with the scoring effects of the ordinary set-screw form and makes a perfectly safe and desirable device.



SPLIT COLLAR WITHOUT PROJECTIONS.

AN ADJUSTABLE WRENCH.

The illustration shows the principle of a wrench of English invention which has the feature of limited adjustment, allowing it to accommodate itself to hexagon nuts of various sizes within its range. The piece D has an opening that is of a distorted hexagonal shape, one diameter being greater than that at right angles to it. The piece B is pivoted at C on the handle A which has the cam-shaped end swinging through the slot cut in B. The nut to be turned is thus held between the sides D and E which make an angle of 60 deg. with the side F, and the end of



ADJUSTABLE BOX WRENCH.

the handle which swings around until the cam-shaped part rests solidly on the side of the nut. The largest nut that can be accommodated, is, of course, limited by the size of the opening in B, while the smallest nut that can be safely turned is one having its sides of a length equal the side F of the part B.

It would seem that such a wrench must be of very limited value as while it may be strong and reliable, it is necessarily, from the nature of its form and construction, rather awkward and slow in use.

MACHINE WORK AT SCHENECTADY.

At Schenectady, N. Y., the observing mechanic finds much food for "think" on mechanical subjects, especially at the Schenectady Locomotive Works or the plant of the General Electric Co. Modern tools abound in both places, but there is a distinct lesson to be learned by most of us in each of these shops.

In the locomotive works we find what may be called the extreme amount of machine work on forgings of all kinds and a corresponding decrease of blacksmith work as devoted to finish. At first glance we comment to ourselves on the poor forgings which appear to have been made with very little regard for the final shape of the finished piece. Rod end forgings, for example, bear little resemblance to the shape to which we are accustomed but appear more like A in Fig. 1 than like B, the finished piece. The same is true of the straps and other pieces. This is

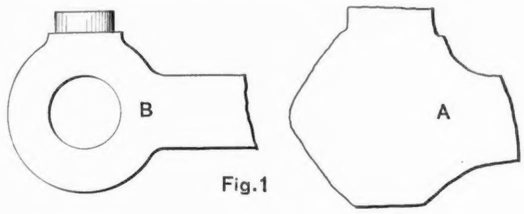


Fig.1

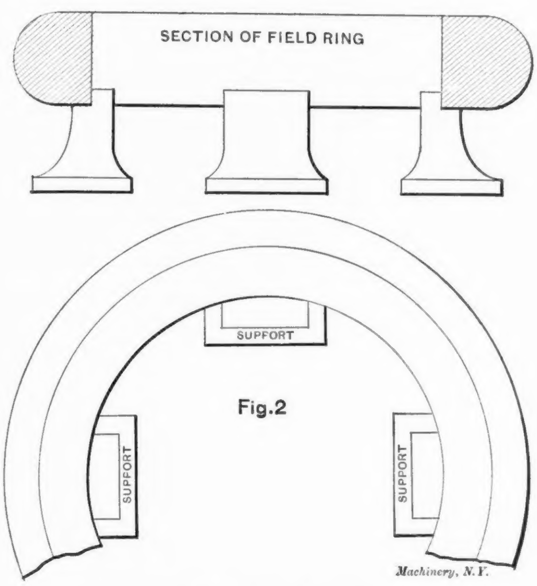


Fig.2

TWO EXAMPLES OF WORK.

not, however, due to a lack of good blacksmithing, but to the method employed of getting out forgings as cheaply as possible and of doing practically all the shaping on the machines. Experience has proved this to be the cheaper way of doing this work and it is certain that by the use of machines an amount of metal can be removed in a short time that would open the eyes of some shop men. Milling machines are used for nearly all work of this kind, and vertical and horizontal spindle machines are also much in evidence.

The other phase of shop work referred to is found in the General Electric Company's main machine shop in the shape of portable tools. In truth, these are called portable only because of their increased facility for handling heavy tools, some of which weigh several tons. They would hardly have been called portable a few years ago.

In the floor of the shop is a large cast-iron bed plate 20 by 120 feet, thoroughly grouted and bedded on the foundation. On this the large work is placed and the tools are located around it to the best advantage.

During a recent visit we saw several large field rings for generators, some of them 20 feet or more internal diameter. Inside these are slots to be slotted or planed, milled to a dovetail, and holes to be drilled and possibly tapped. The rings are placed on supports similar to those shown in Fig. 2 and the slotter is placed inside. A cable and a snatch block in the floor enable the crane to pull the casting into any desired position and it is surprising how well it can be handled with a little practice. It is no uncommon thing to see two and three tools at work on a single casting, which is enough to make the mechanic of the old school stop and note the great change that has taken place of recent years.

Among the tools found at the shops of this company was a Morton draw-cut shaper with a ram about five feet long, but built with a saddle carrying the ram, the whole arranged on a vertical column. This is another case of bringing tools to the work and this is the first shaper I have seen whose ram moves vertically.

Most of the portable tools were built by Newton, of Philadelphia, and all have independent electric drives. It is well worth a visit to see the methods used and to watch the results.

X. Y. Z.

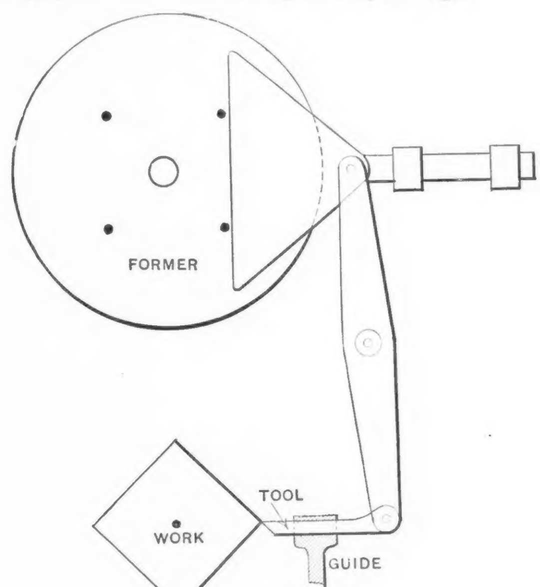
* * *

What a holding up of the hands in horror there would have been ten years ago, says the "Electrical Review" if anybody had suggested electric motors as the prime movers of a powder mill! Yet the art of constructing these machines has advanced so far that the induction motor is to-day considered the safest power machine for such uses. The equipment of the new powder factory of the United States Navy Department is of interest in showing the feeling of safety that has been engendered by the perfection of the electrical transmission and distribution of power. The induction motor has been said to be "as simple as a grindstone." Likewise it is as sparkless as a water-wheel, and in a dangerous place like a powder factory, as safe as a block of ice.

* * *

A SIMPLE FORMING DEVICE.

At the recent anniversary in commemoration of the seventy-fifth birthday of the Franklin Institute, there were many interesting things said by the various speakers. Among these was a paper by W. F. Durfee, who is so well known as an authority on the history of things mechanical and from a large number of interesting illustrations we reproduce the following which is dated 1752, one hundred and forty-seven years ago.



FORMING DEVICE USED IN 1752.

The work and the former are both turned in unison by gears of chains and the four pins in the forming wheel act on the triangular piece above and so operate the tool. The device is readily understood and is merely useful as a suggestion for other applications.

* * *

TO BE NOTED.

In Prof. VanDervoort's article in the last number it should have been stated that the chuck shown in Fig. 35 is the I. X. L. Independent chuck made by the Westcott Chuck Co., Oneida, N. Y. Inadvertently credit was omitted.

In the description of the Universal Turret Lathe on page 84 of the last number, we stated that the machine had recently been brought out by the Prentiss Tool and Supply Co., of this city. We should have said that the lathe is built by Messrs. Fay and Scott, Dexter, Maine, for The Prentiss Tool and Supply Co.

PIPE CUTTING MACHINE.

The tube or pipe cutting machine shown in the accompanying illustration has recently been placed on the market by the Fox Machine Co., Grand Rapids, Mich., for cutting pipe from $\frac{3}{8}$ to $2\frac{1}{2}$ inches in diameter. It is constructed on the same general principle as their smaller machines, but is built heavy enough to withstand the pressure required in parting heavy tubing.

The lower bearing rolls are hardened steel, large in diameter and are carried in the adjustable bearing block which is elevated and lowered by the hand wheel shown on the front of the machine, motion being transmitted through a pair of bevel gears. The long hand lever seen at the left operates a cam under the plunger which carries the bearing rolls. When the lever is depressed it raises the rolls $\frac{3}{8}''$ and forces the pipe that is to be cut against the cutter.

FOX PIPE AND TUBE CUTTER.

On the main driving shaft is a hardened sleeve just back of the cutting disc, which in turns bears against two anti-friction bearing rolls at the top and distributes the pressure of the cut over a large surface. The lower bearing rolls can be adjusted to cut pipe of the various diameters within the capacity of the machine.

When the adjustment is made, it brings the pipe just clear of the cutting disc, the pressure on the handle forces the bearing rolls of the pipe against the rotary cutter, quickly separating the tubing, and a piece of ordinary steam pipe one inch in diameter can be cut in ten seconds. It is said that a piece of steam pipe $2\frac{1}{2}''$ in diameter can be cut in 30 seconds.

Actual time taken from a machine at the Pope Tube Works showed that 26 cuts were taken in 5 minutes on $1\frac{1}{8}$ inch diameter No. 11 B. W. C. soft tubing and the same number in $5\frac{1}{2}$ minutes on $1\frac{1}{2}$ inch hard stock, with records for other sizes in proportion. The machine is heavily geared, with ample driving power and weighs 450 pounds.

* * *

The purpose of the naval engineers of the government is to have the new battleships combine as far as possible the good features of both battleships and cruisers. They will have a speed of 20 knots and will have a belt line of seven inches of the latest armor, which is as effective as 12 inches of the armor plate made a few years ago. They will be provided with triple screws, two of which will be used for ordinary cruising.

NOTES OF THE MONTH.

REPORT OF THE BUREAU OF STEAM ENGINEERING.

The annual report of the Chief of the Bureau of Steam Engineering has recently been issued. It contains the usual reports of the naval stations and other divisions of this department, with recommendations for their future successful operation. Of these the most timely is what is said about the new plant now being erected at the Brooklyn navy yard, where the shops were burned last February. Plans have been formulated in detail for new machine shops and commencement of the work has been delayed only because of excessive bids. In the meantime the shop work has been carried on in temporary quarters. An appropriation of $750,000 has been made by Congress for the new shops and when they are finished they will be one of the most complete and efficient plants in the world. Electric driving has been adopted for the shops in view of the advances made in this direction by the most progressive outside establishments, no steam will be used outside of the power house except for heating, and the latest pneumatic apparatus will be installed. The fact that eighty-nine vessels were repaired at this yard the past year indicates the importance of this station.

From a technical standpoint the chief value of the report lies in the records of tests made by the department during the past year and in the discussion presented by Admiral Melville upon the merits of electric driving for the auxiliaries on shipboard. As we publish in another part of this issue an abstract of a paper by the Admiral upon the merits of water-tube boilers for naval use, we will defer the subject of auxiliaries until a later number. The tests referred to were upon the Babcock and Wilcox, and the Niclausse boilers, and upon the machinery of two of the Great Lake steamers, one of which was fitted with automatic stokers.

The report concludes with a statement of the progress that has been made upon the various ships of the navy now under construction and a very complete set of tables showing the displacement, type of engines, cylinder diameters, types and dimensions of boilers, trial speed, horse-power, capacity and present condition of the United States naval vessels, 125 in all. There are now building eight battle-ships, four coast-defense monitors, one protected cruiser (the Albany in England), 16 torpedo-boat destroyers and 23 torpedo boats. Of the battleships, the Kearsarge has had her trial, and reached an average speed of 16.8 knots; the Kentucky is at New York in preparation for her trial; the Illinois will probably be ready next May; the Alabama in January; the Wisconsin in May, and the Maine in May, 1901. The Ohio, it is expected, will be completed shortly after the Maine, and later still will come the Missouri. The monitors will not be completed until the spring of 1901, and most of the torpedo boats and destroyers are either completed or will be within a few months.

WIRELESS TELEGRAPHY.

Mr. Marconi, who conducted experiments in wireless telegraphy during the yacht races, has performed experiments before a naval board for the United States Government during the past month. The cruiser New York and the battleship Massachusetts were used for the purpose. The former anchored off Navesink, N. J., and the latter proceeded out to sea and tested the effectiveness of the apparatus at long ranges. Messages were exchanged once in ten minutes as the Massachusetts steamed out to sea, and interference messages were also sent by an operator stationed at an instrument located on land, near the shore. The interference messages were successful and rendered the messages between the war ships unintelligible. When no interference messages were sent the transmission between the warships was considered satisfactory, but at a distance of 36 miles the messages failed to reach their destination. Mr. Marconi has now left, ostensibly to assist the British Government in the war at the Transvaal. He claims that he had not received sufficient notice to prepare his instruments for the tests in this country and that he has apparatus that will effectually prevent interference on the part of a third operator when two are communicating between distant points. His system appears to work reasonably well, considering the comparatively short time that he has been experimenting with it, but it remains to

be demonstrated that he can prevent interference. One suspicious circumstance is that he prefers not to give a complete demonstration of his interference devices at present, owing to the fact that they are not protected by patents. He asks also that the naval experiments in this country be not considered as a test of the system since the instruments used were of an old type intended only for short distance work.

JUNIOR M. E. MEETING.

The second local meeting of the Junior Mechanical Engineers was held at the rooms of the A. S. M. E. in this city on the evening of November 7. The paper was upon compound locomotives and was given by Mr. Fred H. Colvin, formerly Editor of MACHINERY and now assistant manager of "Locomotive Engineering." He traced the history of the compound and described the modern types, giving also practical bits of information. The first compound in America was built by Perry & Lay in 1867 at Buffalo. It had four cylinders, two on each side arranged tandem, and was used on the Erie road. Work was done by Anatole Mallet in France as early as 1876 upon a two-cylinder compound. He was the first to use a reducing valve, which, however, was not a success. In 1870 a two-cylinder compound was designed by William Baxter and built by the Remingtons at Ilion, N. Y. It had an intercepting valve in the control of the engineer, but no reducing valve. The Webb compound came next and was built with either three or four cylinders. The high pressure cylinders were connected with the rear drivers and the low pressure by the crank axle with the forward drivers. The two pairs of drivers were not connected. Worsdell in England and Van Borries in Germany brought out engines in 1887 that can be compared with Baxter's. In the United States the Schenectady, Baldwin and Rhode Island locomotive works all brought out compounds at about the same time, in 1890 and 1891.

The paper was illustrated by lantern slides, showing the operation of the different types of compounds and an interesting discussion followed, in which Mr. George L. Fowler, Prof. Hutton and others took part. Much of this discussion was in the nature of criticisms that were not altogether favorable to the details of certain designs of compound locomotives.

OBITUARY NOTES.

Mr Ottmar Mergenthaler, the inventor of the linotype type-setting machine, died at his home in Baltimore, Md., aged forty-five years. He was of German birth and came to the United States when eighteen years of age, being at that time a watch and clock maker.

The invention and successful completion of the type-setting machine made him famous, as it greatly advanced the art of paper and bookmaking. The linotype is probably the most complicated machine in ordinary, everyday use, and an examination of it cannot but impress one with the fact that its inventor must have possessed extraordinary ingenuity. One of its features which renders the machine a practical success, the wedge justifying device, is not, however, the invention of Mergenthaler, but was purchased at a heavy cost by the company to complete the machine. It is a sad fact that the last five years of this great inventor's life was spent in a hopeless fight with consumption, and, as previously stated, he died at forty-five, or at what should have been the prime of his life.

We note that General Thomas W. Hyde, of the Bath Iron Works, died at Old Point Comfort, Va., on November 14, aged fifty-eight years. After serving honorably in the War of the Rebellion, he leased the Bath Iron Foundry and started business in a limited way, becoming manager in 1888 of the Bath Iron Works, which had been incorporated with the Bath Iron Foundry.

Leonard Ames, head of the Ames Iron Works, and for half a century one of the most prominent and wealthy manufacturers of Northern New York, died at Oswego, N. Y., recently, aged eighty-one years.

* * *

ADDITION TO THE GLEASON TOOL WORKS.

The Gleason Tool Company, of Rochester, N. Y., have just completed and occupied a substantial three-story addition to their works, 105 by 120 feet. Their ground, which comprises about an acre, is now covered with buildings excepting a small area for light and ventilation, and the plant is conveniently located in the center of the city of Rochester on the Genesee River, from which abundant power is obtained.

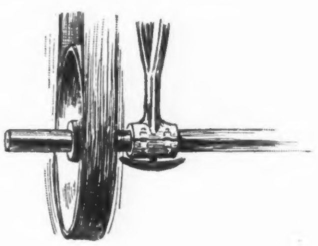
All the Gleason family, who comprise the firm, are thorough mechanics, and their inventions, especially in connection with gear cutting, have been of great practical value to manufacturers everywhere, while the success of the company from a financial standpoint has been in a great measure due to the unusual business ability of Miss Kate Gleason, the secretary, who not only learned her trade in the works, but has traveled extensively over this country and Europe introducing their products.

* * *

Mr. James Vose, Manchester, England, writes us that, war having broken out between England and the Transvaal, about 200 men of the Volunteer Royal Engineers employed at the Crewe works have been called for immediate service at the front, working military trains, etc. The government have these men on reserve, giving them about half the pay of regulars while on civilian duty, and being entitled to call them at a few hours' notice for service in the field. The railway company is reserving the positions for the men while away and grants them half pay during their absence. This, it appears to us, shows a very liberal spirit on the part of the management.

* * *

SHOP TERMS ILLUSTRATED.



LOOSE PULLEY.

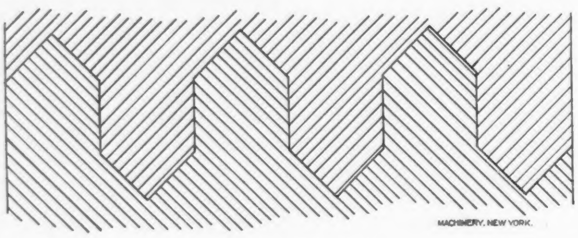
HOW AND WHY.

A DEPARTMENT INTENDED TO CONTAIN CORRECT ANSWERS TO PRACTICAL QUESTIONS OF GENERAL INTEREST.

Give all details and name and address. The latter are for our own convenience and will not be published.

17.—Draughtsman writes: I should be glad to know what is the usual practice in designing the clutch for a friction geared head-stock. I have noticed that a friction disc is used for the single driving and a toothed clutch for the back gear. This clutch, however, must have suitably formed teeth in order to drive both ways when reversing. The square toothed clutch does not go in easily when running at a fair speed.

A. Toothed clutches are not much used on modern lathes. A good friction clutch will pull all that the belt will pull, or at least all that the belt should be required to pull, on a well-designed head-stock. The only way to make a "powerful fric-



CLUTCH TEETH.

tion drive" is to make the friction disc either large in diameter or else fast running. The sketch shows a form of tooth that will enter easily and drive both ways if "Draughtsman" still thinks he must have a toothed clutch.—W. L. C.

18.—M. S. J. says he has a boiler on which he wishes to put a saddle tank, and wishes to know if we can give a formula that will enable him to proportion the tank so that it will have a definite volume.

A. There is no formula that will apply, and we think you would not have good success in attempting to proportion such tanks blindly without understanding the principles of mensuration on which the calculations would have to be based. Procure a good arithmetic and study the subject of mensuration. Then lay out an end view of the boiler and tank as far as you can from the dimensions which you assume, making the drawing to scale. You will then be able to divide the drawing into geometrical figures, of which you can calculate the area or obtain any of the dimensions necessary. If you have some friend who has taken mensuration at school you will do well to have him help you a little in person. A very good course on the subject is contained in Jamieson's elementary text book on the steam engine. We can supply this for $1.40.

Another good book called "Mathematics" is mentioned on page 128.

19.—C. R. L.: 1. If a hole be bored exactly one inch in diameter and a pin turned exactly one inch in diameter, how will they fit? 2. If your calipers just touch the inside of a hole and you then set your outside calipers to them and finally turn a piece so that the outside calipers will touch it when calipering it, how will the pin fit the hole?

A.—A little pressure will be required to force them together, even if the hole and surface of the plug are ground and lapped. This does not mean that the hole would be enlarged nor the plug compressed, for they would not as a whole. The resistance would be caused by the minute irregularities rubbing over each other, producing friction. If friction and adhesion could be eliminated, the parts would go together perfectly. Practically, it would trouble most mechanics to fit together a ring and plug gauge with the latter .0001 inch smaller than the former. 2. This question appears to us to be very much like the other. Assuming no springing nor variation from temperature, they would theoretically be of the same size. Practically their relative sizes would depend upon the man.

20.—E. M. S.: 1. Please inform me as to the most practical method for cutting two, three or four threads to the inch. 2. Also, would you kindly explain a system of running the carriage back by hand in screw-cutting and catching the thread in even numbers or fractions.

A.—It must be remembered that in double, triple and quadruple threaded screws the pitch of the screw is not the distance from thread to thread, but from a point on one thread to the corresponding point on the same thread after it has completed one turn, measured parallel to the axis of the screw. Thus, in a double-threaded screw of one-inch pitch it would measure one-half inch from thread to thread, but the lathe gearing must be set to cut only one thread per inch. To cut a triple screw, with one-half inch from thread to thread, the lathe must be geared to cut a thread in 1½ inches; and for a quadruple thread, one in two inches. After completing one thread the carriage must be moved along, independent of the screw being cut, one-half, one-third, or one-quarter the distance between the spirals of the first thread. Some may prefer to do this by throwing out the half-nut and moving the carriage into position for the next thread by hand and others may prefer to drop out the intermediate change gear and turn the lead screw the proportionate number of turns required to move the carriage the necessary distance. 2. Methods of catching the threads were fully explained on page 287 of the May, 1899, issue, to which we will refer you.

21.—A. J.: 1. Would phosphor bronze or brass connections be as strong for motor carriage work as drop forgings? It would be quite an expense for me to obtain drop forgings and I wish to obtain something of the sort. 2. Can you give me the address of any firm making vaporizers for gas engines?

A. The brass would be decidedly inferior. Any first-class brass foundry, however, should be able to make you bronze castings that would be satisfactory. They would have to be heavier than the drop forgings and there would always be the danger of unsound metal, due to blow holes and impurities, but many bronzes have a tensile strength equal to that of mild steel. Making all due allowances, we think you would be safe in considering average castings of good bronze to have one-third the strength of steel or 20,000 to 25,000 pounds per square inch. 2. Nearly all manufacturers of gasoline engines make vaporizers or carburetters. You will find their advertisements in the various technical papers and in the treatise on Gas, Gasoline and Oil Engines, by Hiscox, price $2.50, is a long list of manufacturers as well as a chapter devoted to carburetters. This book would probably help you.

22.—T. H. G.: Kindly tell me how many foot-pounds of work are equivalent to the number of thermal units required to raise 42 pounds of water at 319 deg. Fahr. to steam at 330 deg., the steam being saturated.

A.—We find by referring to the steam tables that one pound of water at 319 deg. contains 286 thermal units and that one pound of steam at 330 deg. contains 1182.6 thermal units. The difference, 893.6, is the number of thermal units necessary to convert one pound of water to steam at the higher temperature. This multiplied by 42 pounds and again by 778, the mechanical equivalent of heat, gives 29,199,277 as the number of foot-pounds of work corresponding.

23.—Z.: It is my impression that in marine practice the boiler feed water is taken mostly from the hot well and that the evaporators are called upon only to make up the loss due to leakage. If this is correct, I would like to know what means are adopted to separate the oil from the exhaust steam.

A.—Generally there is no provision for this. With evaporators to supply the deficiency of water the boilers can be blown down occasionally, and if a good quality of oil is used and only a reasonable quantity, the results are not serious. Oil separators could be used, but experiments show that they cannot in general be depended upon to extract more than 50 per cent. of the oil. Filters are also available. At a meeting of the Institution of Marine Engineers held in England last October this question was discussed at length and the opinion was expressed that neither separators nor filters would attain much success in marine engineering. If any readers who have had experience in marine work can give further information we shall be glad to receive it.

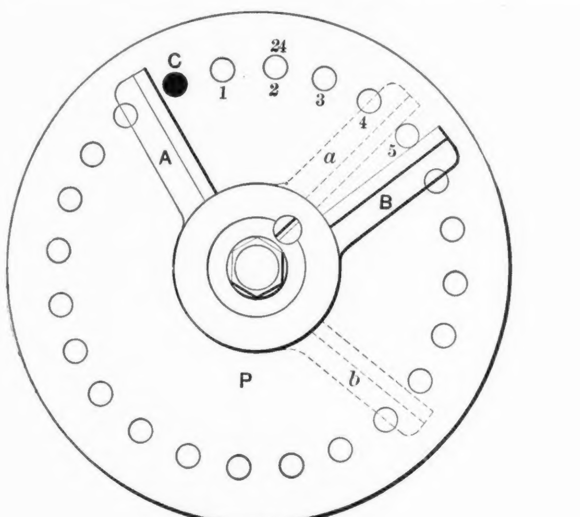
24.—S. A.: Will you kindly give me some information about spacing work such as gears, taps, reamers, etc., on the milling machine. I have an index table, but do not understand it. It is divided into columns, the first of which reads at the top, "No. of Teeth"; the second has a heading reading "Circle"; the next, "Turns," and the last, "Holes."

A.—This index table is to assist you to use the dividing head of the index centers with which we presume your machine is

provided. If you will examine the index head, you will find that it has an index plate in which there are series of holes ranged in circle. Each circle is stamped showing the number of holes that it contains. There is also an index arm carrying a spring pin that can be adjusted to fit into any hole in the disc. To assist in spacing there is also a sector which has two arms or fingers, as shown in the sketch at A and B. To illustrate the use of your table, suppose you find the following numbers under the different headings:

No. of Teeth.	Circle.	Turns.	Holes.
2	Any	20	—
3	18	13	6

The first line means that when your work is mounted between the index centers you can cut two grooves or teeth, one on each side of the piece of work, by turning the index arm 20 times, without regard to any particular circle of holes. The second set of figures means that to make three equidistant spaces you must select the circle marked 18 and adjust the spring pin of the index

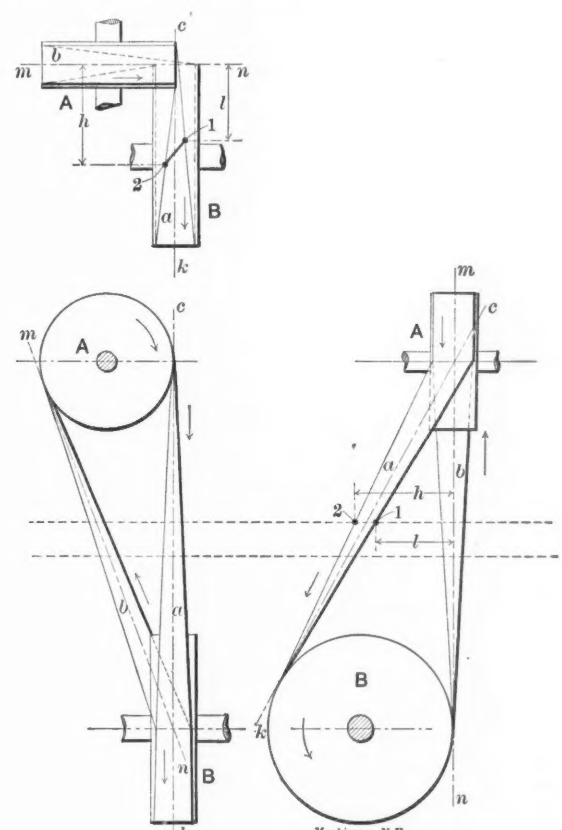


INDEX PLATE.

arm so that it will have the correct radius to fit into the holes of this circle. Next, give the arm thirteen turns and then move it along six holes further. This operation must be repeated every time it is wanted to space the work. To show the use of the sector, suppose you want to space off five holes on the index plate each time on a 24 circle. It would cause some trouble to have to count these five holes each time and so we set the arms of the sector just six holes apart. The first hole C is not counted as one of the five holes that is to be spaced, because there must always be one hole for the pin to occupy and if the sector arms are six holes apart, this will leave five holes for the pin to be advanced each time. After the pin and dividing arm have been moved ahead to hole 5, the sector is advanced to the dotted position and it is ready to guide the index pin in spacing off five more holes. You will find this and many other matters pertaining to the milling machine explained much more fully in the books upon the milling machine published by the Brown & Sharpe Manufacturing Company, Providence, R. I., and the Cincinnati Milling Machine Company, Cincinnati, Ohio.

25.—H. E. F.: I enclose a rough sketch of a quarter turn belt drive and will thank you to inform me as to the best way to lay out the belt holes in the floor so as to conform to the twist of the belt.

A.—The sketch furnished by H. E. F. shows the quarter turn belt passing through two floors and gives all dimensions necessary for locating the pulleys and shafting. It is not feasible for us to attempt to furnish complete solutions with dimensions to problems requiring so much work as this one, and we therefore present below directions for working it out, which, we think, if carefully followed, will give results nearly enough correct. For simplicity we show only one floor. It is understood, of course, that a quarter-turn, or in fact any belt must be delivered into the central plane of the pulley which it approaches; that is, when a belt leaves a pulley, the center line of the belt must be in the central plane of the next pulley and at right angles to its shaft. The sketch shows a quarter turn belt with the two sides of the belt leading on to the pulleys in this way. The upper view is a plan and the two others are as one would see the two pulleys and the belts in looking first at the end of the upper shaft and then at the end of the lower shaft. To avoid confusion the corresponding parts, a and b, of the belt are marked in each view and the pulleys are marked A and B. The central lines mn and ck of the two pulleys furnish the basis lines from which to measure and these can be easily laid out on the floor by the aid of the drawing and plumb line. In the two other views the vertical and slanting projections of lines mn and ck are shown and lettered to correspond with the plan view, but for our purpose the vertical lines only are necessary. Now, referring to the right-hand view, we see that one edge of side "a" of the belt passes through the top of the floor at point 1 and that this point is at a distance l from the vertical line mn. Return to the top view and measure down from the horizontal projection of line mn, marking the point 1 on the right-hand edge of the belt equal to a distance l from line mn. Again, in the right-hand view, we find point 2 of the other edge of the same part of the belt to be at a distance h from the vertical line mn and transferring this distance to the plan view we get point 2 on the other edge of the belt at a distance h from the horizontal projection mn. Connecting points 1 and 2, the plan view gives the location of the top of the hole in the floor and a similar process will give the location of the hole on the lower side of the floor.



LOCATING BELT HOLES IN FLOOR.

Now, for side "o" of the belt we must take the measurements from line ck in the left-hand view and transfer the measurements to the top view, using this time line ck as a base line instead of line mn. This method of solution depends upon the accuracy of the drawing and is open to the objection that it is not easy to determine at just what points the belt leaves the pulleys. Where the length of the belt is long compared with the diameters of the pulleys, however, this will not produce a serious error and it will probably answer to assume that the belt leaves in each case at the center line of the pulley.

In reply to "A. H.," question 12, in the last number, who inquired about engines for a 40-foot launch, Mr. Henry Moore, 7 Woodruff Place, Auburn, N. Y., writes that he has engine castings suitable for a boat of this description, and we presume he will be glad to furnish information about them if desired.

FRESH FROM THE PRESS.

Jim Skeevers' Object Lessons, by John A. Hill. A book of 157 pages on railroading for railroad men. Published by the American Machinist Press, New York. Price $1.00.

This book is a reprint of the humorous and instructive sketches that appeared a few years ago in the "Locomotive Engineering" and are in a measure to railroad men what Chordal's letters were to machinists. Probably they also did as much in making the former journal popular with railroad men as Chordal's Letters did for the "American Machinist" amongst mechanics. The sketches tell in an interesting manner the trials and tribulations "Jim Skeevers" met in working his way from a freight engineer to superintendent of motive power on a mythical railroad which probably would not be so very mythical if the true names of men and places were given. The absurdities of the false economy practiced by many railroad officials are well shown by the inimitable "object lesson" of the doughty Skeever, and the life of a railroad man is portrayed as can only be done by one well familiar with both the pen and all the phases of that peculiar business. The only unfavorable criticism we have to offer is that in the scheme of the book the author has seen fit to omit the sketches that accompanied the original text. Jim Skeevers' method of cylinder and frame fastenings is well worth reproduction by more than the printed description, as is also his method of connecting the exhaust pipe to the top of the steam chest cover and allowing the exhaust to escape in nearly a straight path. In the latter improvement (?) many railroad men will recognize an old friend which has probably been invented scores of times by the would-be improvers of the locomotive, and it thus makes a double-barreled "object lesson" in more ways than one.

Hendricks' Directory of Architectural, Engineering, Contracting, Mechanical and kindred industries. Published annually by Samuel E. Hendricks Co., 61 Beekman street, New York. Price $5.00.

This work contains over 900 pages and has lists of manufacturers and dealers in the branches mentioned. It is valuable as a buyers' reference book containing, as it does, lists of the manufacturers and dealers related to everything employed in the manufacture of material and apparatus for the leading industries. At the beginning is an index of contents, an alphabetical list of architects and a classified list of architects. There is a list of carpenters, contractors and builders, by states; of engineers; of heating contractors; of masons and builders; of gas fitters and roofers and of men in other departments of work. These, in addition to the lists of manufacturers, add materially to the utility of the book.

The Use of the Slide Rule, by F. A. Halsey. Published by D. Van Nostrand Co., 23 Murray and 27 Warren streets, N. Y. New edition. Price 50 cents.

This is one of the books of the Van Nostrand science series and is in pocket form. It has 84 pages, besides several folding plates, and we think it is the best American treatment of the slide rule for the ordinary user. Unlike many text books upon the subject, it makes no attempt to show how to work out examples in mechanics, steam engineering, etc., but rather it is confined to a discussion of general principles and an explanation of the slide rule by the aid of excellent diagrams. The principles are explained by the aid of problems worked out.

Mathematics. Published by the Doubleday & McClure Co., N. Y. 340 pages illustrated.

This book is one of the home study circle series that this company are now publishing. It contains five chapters upon mechanics bids and estimates, mensuration for beginners, easy lessons in geometrical drawing, elementary algebra, and a first course in geometry. The book is adapted to home study and the matter that it contains was originally published in the "Chicago Record," so there has been every opportunity for its correction and revision. It is probable that any mechanic who wishes to investigate the elementary principles of mathematics and learn how to work out everyday examples will find the book of value. It has the further advantage that several branches of mathematics are treated in one book, of which the price is low.

The National Railroad Master Blacksmiths' Association has recently published a 216-page book of the proceedings at their seventh annual convention. This book contains information which will prove interesting to those engaged in mechanical pursuits. A few extra copies of this book have been printed and can be obtained for 50 cents from the secretary of the organization, Mr. A. L. Woodworth, Lima, Ohio.

ADVERTISING LITERATURE.

THE STANDARD SIZES FOR CATALOGS ARE 9 x 12, 6 x 9 AND 3½ x 6 INCHES. THE 6 x 9 IS RECOMMENDED, AS THIS SIZE IS MOST LIKELY TO BE PRESERVED.

Howard Iron Works, Buffalo, N. Y. Illustrated catalogue of pulleys, hangers, shaftings, vises, bolt cutters, etc.

A complete line of appliances for power transmission is given with several styles of vises, grindstone frames, bolt-cutters, belt tighteners, etc. There are several useful tables at the end of the catalogue.

E. G. Smith, Columbia, Pa., has sent us a new catalogue of the Columbia measuring instruments which contains a list of tools on which he is making special discounts for a short time.

The New Process Raw Hide Co. have issued a little flyer giving a few pointers about their noiseless pinions.

The Massey Vise Co., 30 and 32 South Canal street, Chicago, have mailed us a catalogue of their various styles of vises, which, besides the ordinary type, includes a quick-acting vise, a combination pipe vise and a quick-acting grip vise for wood workers. A novel milling machine and planer-vise made by this company has jaws which depress and seat the work as it is clamped.

MANUFACTURERS' NOTES.

The Newton Machine Tool Works, of Twenty-fourth and Vine streets, Philadelphia, are erecting a new building at Nicetown, for facilitating the filling of their many orders.

The Pratt Chuck Co., of Frankfort, N. Y., are making additions to their plant in order to meet the increasing demands for their product. Among their foreign orders is one from a large railroad company in Great Britain who desire to secure a chuck that will not permit the drill to slip under any conditions and they report a large increase in their domestic orders.

A new company has been organized for the manufacture of a complete line of air compressing machinery under the name of the New York Air Compressor Co. The foundry and machine shop plant of this company are located on the line of the New York and Greenwood Lake Railroad, Arlington, N. J., and the New York offices are at 120 Liberty street.

The Norwalk Iron Works, South Norwalk, Conn., have nearly completed a large addition to their present plant which measures 240x130 feet. The new structure will contain all the modern, up-to-date features and be a model machine shop in every respect.

The Cling-Surface Mfg. Co., of Buffalo, N. Y., report rapidly advancing sales of Cling-Surface, both domestic and large shipments to Mexico and England. Of their many customers the Jeffrey Mfg. Co., of Columbus, Ohio, say: "It is the best material for belts we have ever used." The Standard Hosiery Co., of Philadelphia, report "A gain of 25 per cent. in power, belt very slack and no slipping." Whitehall Electric Light Plant, Whitehall, Mich., say: "Arc light belt 14 ft. between centers, running 4,480 ft. per minute, no slip and 16 inch sag in belt." The General Electric Co. Lamp Works, Harrison, N. J., say: "Have given Cling-Surface a thorough test and it is very satisfactory."

E. G. Smith, manufacturer of fine mechanical tools, Columbia, Pa., announces that there is an increasing demand for his "Which Way" pocket levels, a great many of which are going to foreign countries. He will be pleased to send a descriptive circular to any one interested.

The Tanite Co., Stroudsburg, Pa., still continue to receive large orders for their machines. Among the orders filled is one from the Netherlands Government for a letter "D" machine. They have also received an order from Russia for their surfacing machines and one from an American firm for their two-wheeled No. 5 Grinders. They have also in hand at the present time an order for emery wheels for Russia and New Zealand.

Ottmar Mergenthaler & Co. announced recently that after November 1 their business would be continued on the same lines as heretofore by the Ottmar Mergenthaler Co., a company incorporated under the laws of the State of Delaware.

The Boston Gear Works, Boston, Mass., announce that on or before December 1, they will occupy their new premises, corner of Purchase and Pearl streets, where they will have greater facilities for executing first class work and attending to orders more promptly than heretofore.

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AT THE UNIVERSITY OF ILLINOIS.

Prof. Wm. S. Aldrich, who was appointed head of the department of Electrical Engineering at the University of Illinois, Urbana, Ill., a few months ago, has sent us a prospectus of the courses in engineering which show the changes that have been made in the electrical department. Five years are now required for the degree of electrical engineer, as it is believed that the title has too great a significance to be earned by a four years' study. A wide range of electives is allowed the students and strong courses are being built up in alternating current working, polyphase subjects, metallurgical testing, and practical laboratory work. Prof. Aldrich was one of the engineers in charge of the repair ship Vulcan during the Spanish war and he has evidently entered into his new work with the same energy and good judgment that he displayed in the difficult management of the details connected with the floating machine shop.